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AC Engineering
Annual Progress Report
January 10, 1997

1. *Contract Name:* Development and Application of Contamination Technology for MSFC Managed Space Systems

2. *Contract Nr.* NAS8-39244

3. *Reporting Period:* December 10, 1995 to January 10, 1997

4. *Technical Progress:* This is the fifth annual report for this contract.

   Efforts during the report period included the following activities:

   1. Analyzed contamination standards with the three SIMIR face plates, and developed calibration plots which related spectrum peak heights to coating levels.

   2. Demonstrated that the SIMIR had potential for non-aerospace applications by successfully measuring thicknesses of silicone coatings on diesel engine gaskets.

   3. Performed SIMIR contact analysis of aluminum contamination standards with ›15 mg/ft2 levels of silicone, Fluorolube, or paraffin coatings over measured levels of surface roughness.

   4. Performed SIMIR non-contact analyses of 7075-T73 aluminum panels coated with 10 - 400 mg/ft^2 levels of paraffin wax, 4 - 530 mg/ft2, or 16 - 266 mg/ft2 of Fluorolube to determine their quantifiable upper limits.

   5. Performed SOC-400 IR contact analyses of three 7075-T73 aluminum panels coated with levels of 1, 3, 6, 10 and 15 mg/ft^2 of either paraffin, CRC Silicone, or Tri-Flow mold release. Results from these scans were compared with essentially identical scans performed on these same aluminum panels in December 1995 to evaluate instrument consistency.

6. Performed SOC-400 IR contact analysis of 7075-T73 aluminum contamination standard coated with 5 - 50 mg/ft^2 levels of paraffin. Data from these scans were compared with essentially identical scans performed on these same aluminum panels in March, 1996 in order to evaluate instrument performance after its recent modifications by manufacturer.

7. Performed SOC-400 IR contact analyses of 7075-T73 aluminum panels coated with 1-16 mg/ft^2 levels of paraffin wax, 1-15 mg/ft2 levels of CRC silicone, 1-16 mg/ft2 of Fluorolube, and 1-15 mg/ft2 levels of Triflow teflon; as well as D6AC Steel panel coated with 1-16 mg/ft2 levels of CRC Silicone. Data from these analyses were compared with data from virtually identical scans to further evaluate instrument performance after modification.

8. Performed SOC-400 IR contact analyses of three aluminum contamination standards each with equivalent levels of paraffin, but with different surface roughness.

9. Performed SOC-400 IR contact analyses of Aluminum and D6AC steel contamination standards shipped to Utah and back. Analyzed spectra for evidence of contamination by plastic disk boxes. Performed extraction procedure and FT-IR analysis and identification of extracts from plastic computer disk boxes being used to store and ship contamination standards.

10. Performed SOC-400 IR contact analyses to determine if residual cleaner contamination could be detected on the surface of D6AC steel.

11. Performed comparative analyses of grit blasted steel and aluminum surfaces with the OSEE II and OSEE III systems. Quantified impact of argon purge to sensor/substrate gap region on OSEE III analysis results.

12. Performed experiments to evaluate the effect of argon flow rate to the OSEE III sensor/substrate gap region on D6AC response trends, as well as experiments that coupled argon flow rates and scan speeds in continuous scan mode.

13. Evaluated the effects of discrete and continuous scan modes and scan speed on OSEE III response trends for grit blasted D6AC steel panels.

14. Have replaced dying, unreliable bulb in OSEE III Sensor #2 with bulb sent to us from NASA Langley. Filmed the procedure for training of others who might perform this task in the future. Attempt underway to calibrate sensor for testing with recently-acquired Rack.

15. OSEE III: Coordinated with Thiokol personnel for generation of procedure for bulb replacement in 6" sensors. This procedure required vapor degreasing of replacement bulb prior to insertion into sensor and construction of appropriate apparatus for this process. Replaced unstable bulb in OSEE III Sensor #2 with bulb sent to us from NASA Langley. Have attempted to stabilize bulb for calibration and testing.

16. Performed OSEE III scans with Sensor #2 using "Old" Rack (NASA #125531) at different scan speeds as baseline for testing with Rack shipped back from Utah 11/95 i.e "New" rack (NASA #135532).

17. Performed OSEE III scans with Sensor #2 using "New" Rack, to evaluate its performance. Performed scans with Sensor #8 using "New" rack, as well.

18. Installation of the Guided Wave Model 260 Fiber Optic Spectrophotometer (NIR) was initiated.

SOC-400 SIMIR Evaluation

The SOC-400 Surface Inspection Machine Infrared Spectrometer (SIMIR) was designed to analyze coatings and contamination on rough surfaces such as grit blasted steel and aluminum. The measurement head is small (approximately 1 square foot), light weight (12 lb), portable, and has an industrially hardened design. The instrument has three face plates and therefore three analysis modes: contact with the surface (#1 contact plate); non-contact with a recommended 20 mil stand-off distance; and contact with a hermetic seal (KBr Plate).

Analysis of Contamination Standards

Contamination standards which consisted of grit blasted D6AC steel or 7075-T73 aluminum substrates coated with various levels of CRC Silicone, Tri-Flow mold release, paraffin or Fluorolube were analyzed with the three SIMIR face plates. The principle objectives of the studies were to develop calibration plots which related spectrum peak heights to coating levels, and to compare the relative sensitivities of the three face plates to model organic contaminants on metallic surfaces. Scan parameters were 48 pulses at a resolution setting of 16 cm^{-1}, which required approximately one minute per spectrum. The recommended stand-off distance for the non-contact face plate was 0.02", but the initial analyses were performed at 0.05"-0.06" because the signals reaching the detector were maximized at those distances. Coating detection/quantification limits were estimated based on Signal-to-Noise (S/N) ratios, which were calculated by dividing peak heights by baseline noise levels in a region close to the peaks of interest (2500-2700 cm^{-1} for paraffin and Tri-Flow, 1500-1700 cm^{-1} for CRC Silicone and Fluorolube). S/N ratios less than three were considered unacceptable for peak height measurements.

Table 1 and Figures 1-7 summarize the analysis results. For all combinations of substrates, coatings and face plates, spectrum peak heights increased linearly with coating levels (1-16 mg/ft^2). Although peak heights would not be expected to increase indefinitely with coating levels, the upper limits were not determined.

As illustrated in Figures 8-9, spectrum baseline noise levels differed significantly for the three face plates. Noise levels were generally lowest with the #1 contact plate, intermediate with the non-contact plate, and highest with the KBr plate. As a result, the #1 contact plate exhibited the highest S/N ratios (Table 2) and the lowest contamination detection limits (Table 3) of the three analysis modes. Conversely, the KBr plate had the lowest S/N ratios and the highest detection limits. Noise levels were highest for the KBr plate because relatively small percentages of IR signals reached the detector compared to the other two plates (Table 4).

Detection limits for all model contaminants and substrates were significantly lower with the #1 contact and non-contact face plates than limits observed with the FT-IR microscope. For example, the microscope detection limit for CRC Silicone on aluminum was 25-30 mg/ft^2, compared to 2-3 mg/ft^2 with the #1 contact plate and 6-8 mg/ft^2 with the non-contact plate. Although detection limits were also generally lower with the KBr plate than with the microscope, results were equivalent for paraffin on steel and CRC Silicone on aluminum.

Effects of Resolution Setting and Stand-off Distance on Non-Contact Analyses

Although peak heights were generally similar for spectra obtained with the #1 contact and non-contact face plates, S/N ratios were 40-70% lower for the non-contact plate due to higher levels of baseline noise. It was believed that S/N ratios with the non-contact plate might be improved by performing analyses at higher resolution settings, which would reduce the number of data points obtained over a given spectral range.

The SIMIR was adjusted to a 32 cm^{-1} resolution setting (the next available setting higher than 16 cm^{-1}), and the contamination standards were reexamined. Linear correlations were again observed between coating levels and peak heights (Table 5), but S/N ratios (Table 6) and estimated coating detection limits (Table 7) were not improved relative to the 16 cm^{-1} results. Analyses performed at stand-off distances of 0.02" yielded similar outcomes. Estimated contamination detection limits for the non-contact face plate were similar for gap sizes ranging from 0.02"-0.06", and for resolution settings of 16 cm^{-1} or 32 cm^{-1}. These results indicated that non-contact analyses could be performed using any combinations of these settings without significantly impacting the results.

Analysis of McCord-Payen Gasket

The SCAT Team was provided with an opportunity to demonstrate the capabilities of the SIMIR for non-aerospace applications. The McCord-Payen corporation, a manufacturer of gaskets for diesel engines, asked NASA to help identify a non-contact technique that could be used to measure the thicknesses of RTV Silicone coatings that are spray applied to the gaskets. Based on the success of experiments which demonstrated that IR peak heights correlated to CRC Silicone coating levels on steel and aluminum substrates, it was believed that the SIMIR would be an effective analysis tool.

The silicone coatings on the finished gaskets were believed to be approximately 25-35 micrometers thick, therefore a step-plate calibration standard was prepared with coatings ranging from 10-40 micrometers. To prepare the standard, RTV silicone (provided by McCord-Payen) was painted onto an uncoated gasket using a sponge brush. Thickness levels were initially estimated based on gravimetric measurements, and were then more accurately determined using a light-section microscope and the formula below:

$$\text{Thickness} = \text{microscope line space X } (\text{sqrt } (2(n_D)^2 - 1)),$$

where n_D was the index of refraction of the coating

As shown in Table 8, two estimates of n_D were used to determine coating thicknesses on the calibration standard: The first, n_D=1.38, was based on literature values for typical silicones. The second, n_D=1.22, was obtained by measuring the thickness of the heaviest coating on the standard and then solving the equation in "reverse". The calculated coating thicknesses were similar for the two indexes of refraction, and were close to the target values.

Table 9 and Figure 10 summarize results from light-section microscope analyses of a sprayed gasket obtained from McCord-Payen. Silicone coating levels ranged from 35-43 micrometers, excluding the "landing" area between the two piston holes where the coating was only 28 micrometers thick. Based on these data, it was concluded that the MSFC step-plate was an appropriate calibration standard since its coating levels bracketed those observed on an actual production article.

Figure 11 shows an IR spectrum obtained from the 30 micrometer coating of the calibration standard. Scan parameters were 0.05"-0.06" stand-off, 16 cm^{-1} resolution, and 4 pulses per spectrum; the total scan time was approximately 5 seconds. The analysis was performed prior to curing the silicone, as would be required in the production scheme. Unfortunately, the predominant C-H stretch peaks (2950 cm^{-1}) and Si-C stretch peaks (1265 cm^{-1}, 830 cm^{-1}) were so strong that they could not be kept on scale at thickness levels of 20 micrometers and higher. However, the smaller C-H stretch peak at 2905 cm^{-1} did stay on scale, and it exhibited a linear increase with silicone coating thicknesses (Figure 12).

Also shown in Figure 12 are SIMIR analysis results from 3 spots (labeled A, B and C in Figure X) on a sprayed gasket. The peak heights (Absorbencies=1.36, 1.39, and 1.53) indicated that coating levels were between 33-38 micrometers thick (based on n_D=1.38), which were in line with the light-section microscope measurements.

Based on these results, the SIMIR would potentially be suitable for monitoring the thickness levels of silicone coatings as they are spray applied to gaskets. A summary of the data was presented to representatives of McCord-Payen, who expressed an interest in returning to MSFC for additional discussions.

Analysis of Aluminum Contamination Standards With Paraffin, CRC Silicone or Fluorolube Coatings

Previous SOC-400 contact analyses of 7075-T73 aluminum panels coated with 1-15 mg/ft2 levels of paraffin wax revealed that spectrum peak heights increased linearly with coating levels (January 1996 and March 1996 monthly reports). Experiments were conducted to determine whether these trends would continue at levels >15 mg/ft^2, and to establish the upper limits for quantification measurements.

To determine whether or not surface roughness (Ra) the contact face plate was used and the scan parameters were 48 pulses per spectrum at a resolution setting of 16 cm^{-1}. A minimum of three spectra were obtained from each coating level, and the results were averaged. Two 8" x 11" aluminum standards were prepared with each contaminant. One had an Ra of approximately 110 μin, which was typical of aluminum grit blasted at 20 degrees with Zirclean media and the second had an Ra of 115-230 μin. The higher Ra was used to determine whether analysis results could be significantly affected by roughness.

Aluminum/Paraffin Contamination Standards

Table 10 and Figure 13 summarize results from 106 μin and 230 μin aluminum standards with paraffin coating levels from 4 - 55 mg/ft^2. For both specimens, C-H stretch peak heights (2915 cm^{-1}) increased with coating levels. From 4 - 20 mg/ft^2, the line slope for the 106 μin panel was approximately twice as high as the slope for the 230 μin panel. From 20 - 50 mg/ft^2 the slopes were similar , but peak heights were 30-40% higher for the 106 μin panel.

Aluminum/CRC Silicone Contamination Standards

Table 11 and Figure 14 summarize results from analyses of aluminum standards with CRC silicone contamination levels up to 60 mg/ft^2. For the 110 μin and 168 μin specimens, Si-C stretch peak heights (1265 cm^{-1}) increased with coating levels. Again, the response trend was best represented by two lines of different slopes (4 - 30 mg/ft^2 and 30-50 mg/ft^2). When plotted this way, the two panels exhibited similar slopes at coating levels below 30 mg/ft^2; however, peak heights were 30-40% lower for the rougher of the two standards.

Aluminum/Fluorolube Contamination Standards

Table 12 and Figure 15 show results from aluminum panels coated with 9 - 65 mg/ft^2 levels of Fluorolube. Line slopes and C-H stretch peak heights (1200 cm^{-1}) were similar for both specimens (112 μin and 115 μin). Perhaps the difference in Ra was not sufficient to cause a marked deviation in results. Over this range of coatings, average peak heights increased linearly with contamination levels.

These findings were incorporated into the analysis parameters for the following experiments. A minimum of three spectra were obtained per coating level at 48 pulses per spectrum and a resolution setting of 16 cm^{-1}. Surface roughness levels for the aluminum panels averaged 90-120 micro-inches and were achieved by grit blasting at 20 degrees with Zirclean media.

Aluminum/Paraffin Contamination Standards

Three 7075 aluminum panels were contaminated with levels of paraffin wax ranging from 10 - 400 mg/ft^2. These panels were then subjected to SOC400-400 non-contact analyses to determine the quantifiable limit for paraffin. As summarized in Table 12 and Figures 16 and 17, the plot of paraffin C-H stretch peak heights (2915 cm^{-1}) versus coating levels exhibited linear increases at all levels tested. From 10-183 mg/ft^2, the slope was 0.0034 (r2 = 0.98) and leveled somewhat to 0.0018 (r^2 = 0.99) from 190-404 mg/ft^2. For the entire test, the correlation coefficient was 0.097. Beyond this coating level, additional testing could reasonably be expected to produce similar linear results, however, it was considered unlikely that data would be useful for such high levels. Therefore, the quantifiable upper limit for paraffin was not determined.

Aluminum/CRC Silicone Contamination Standards

An 8" x 11" step plate contamination standard with 10 coating levels was used for initial analyses of CRC Silicone mold release on aluminum. Although results were acceptable for the initial series of coatings (Table 13), response trends became erratic when the panel was oversprayed with additional silicone. It was believed that the coating level gradients were destroyed when the panel was over-sprayed.

A second series of analyses was performed using standards that had only one coating level per panel. As shown in Table 13 and Figure 18, Si-C stretch peak heights (1265 cm-1) exhibited linear increases with coating levels up to 450 mg/ft^2. Although the quantifiable upper limit for silicone had not been identified, contact analyses were discontinued at 450 mg/ft^2 due to concern that the SOC-400 might become contaminated. However, non-contact analyses showed that Si-C peak heights continued to increase with levels up to 530 mg/ft^2.

Aluminum/Fluorolube Contamination Standards

As summarized in Table 14 and Figure 19, a series of analyses were performed on Aluminum standards with coating levels of Fluorolube ranging from 16 - 266 mg/ft^2. Up to approximately 250 mg/ft^2, the C-F stretch peak height (1200 cm-1) increased linearly. However, above that level that trend ceased to continue. Therefore the quantifiable upper limit for Fluorolube has been established to be 250 mg/ft^2.

SOC-400 Analysis Over Time of Aluminum/CRC Silicone, and Aluminum/Tri-Flow, and Aluminum/Paraffin Contamination Standards

Aluminum/CRC Silicone Contamination Standards

A step plate of 7075 aluminum that had been coated with 1, 3, 6, 10, and 15 mg/ft^2 levels of CRC Silicone was scanned (using the contact face plate) in three separate locations at each level. Si-C stretch peak heights (1265 cm^{-1}) at each site were averaged and compared with averages of virtually identical scans performed immediately after application of the CRC silicone (December 1995). Analysis of the most recent spectra produced a slope of 0.0011 and a correlation coefficient of 0.95, compared with 0.0009 and 0.97 respectively from the initial spectra. Results are summarized in Table 15 and Figure 20.

Aluminum/Paraffin Contamination Standards

A step plate of 7075 aluminum coated with 1, 3, 6, 10, and 15 mg/ft^2 levels of Paraffin was scanned (using the contact face plate) in three separate locations at each level. C-H stretch peak heights (2915 cm^{-1}) at each site were averaged and compared with averages of essentially identical scans performed immediately after application of the paraffin wax (December 1995). Analysis of the most recent spectra yielded a slope of 0.004 and a correlation coefficient of 0.99, compared with 0.0042 and 0.095 respectively from the initial spectra. Results are summarized in Table 15 and Figure 21.

Aluminum/Tri-Flow Teflon Contamination Standards

A step plate of 7075 aluminum coated with 1, 3, 6 10, and 15 mg/ft^2 levels of Tri-Flow was scanned (using the contact face plate) in three separate locations at each level. C-H stretch peak heights (2960 cm^{-1}) at each site were averaged and compared with averages of nearly identical scans performed immediately after application of the Tri-Flow (December 1995). Analysis of the most recent spectra produced a slope of 0.001 and a correlation coefficient of 0.96, compared to 0.001 and 0.98 respectively from the initial spectra. Results are summarized in Table 15 and Figure 22.

Conclusion: The similarity of these data, derived from testing separated by six months, indicates that testing with the SOC-400 can generate consistent, reproducible data.

Analysis of Aluminum and D6AC Steel Contamination Standards With Paraffin, CRC Silicone, Fluorolube or Tri-Flow Teflon Coatings

Aluminum with Paraffin Contamination Standards

The contact face plate was used for the analyses, and the scan parameters were 48 pulses per spectrum at a resolution setting of 16 cm^{-1}. A minimum of three spectra were obtained from each coating level, and the results were averaged.

Two aluminum standards with equivalent surface roughness (Ra) were analyzed with the contaminant. One had an Ra of approximately 110 μin, and the second had an Ra level of 101 μin. Both were contaminated with ten stepped levels of paraffin ranging from 5 - 50 mg/ft^2. The Ra 110 μin panel had been scanned prior to modifications being made to the instrument by the manufacturer. The Ra 101 panel was prepared and scanned after the modifications had been effected, and was used to compare how these modifications might have affected Signal to Noise Ratios. Peak height data was also noted in this study. The results are summarized in Table 16 and Figures 23 and 24. As anticipated, the signal/noise ratio was improved by the modifications made to the SOC. The slope for the ratio was 0.84 before the modifications, compared to a slope of 1.56 after. Peak heights for this study are plotted in Figure 25. Here, also, the slope increased (from 0.0057 to 0.0064).

The analysis parameters for this set of data were 48 pulses per spectrum at a resolution setting of 16 cm^{-1}. A minimum of three spectra were obtained per coating level. Three aluminum standards with surface roughness of 62 μin, 101 μin, and 172 μin were contaminated with stepped levels of paraffin ranging from 5 - 50 mg/ft^2 Slopes of peak heights were compared to determine the effect of surface roughness. The slope for Ra 62 μin was 0.0088. The slope for Ra 101 μin was 0.0064. The slope for Ra 172 μin was 0.0037. It was concluded that surface roughness does, indeed, affect peak height. It also proves that within this range of surface roughness, the rougher the surface the lower the peak height for a given coating/contaminant level. Signal/noise ratios were also examined for this range of roughness, and it was found that the standard with Ra = 101 μin demonstrated the highest ratio between peak height and noise. Results are summarized in Table 17 and Figures 26 and 27.

Aluminum/Fluorolube and D6AC Steel/Fluorolube Contamination Standards

Contamination step plates of both D6AC Steel and 7075 Aluminum were prepared with coating levels of 1, 3, 6, 10 and 15 mg/ft^2 of Fluorolube. Both were scanned using the contact face plate in February, 1996, and again in June, 1996, after instrument modifications. The results from both studies were analyzed and compared to each other to determine what effect the modifications might have on the results. For all practical purposes, there was no difference between the results for peak height (C-F stretch at 1200 cm-1) or slope for the Aluminum/Paraffin standard. Analysis of the results for D6AC Steel/Fluorolube showed no appreciable amount of change in the C-F stretch peak heights after the modifications. The results are summarized in Table 18 and Figures 28 and 29.

Aluminum/Teflon Contamination Standard

A contamination step plate of 7075 Aluminum was prepared with coating levels of 1, 3, 6, 10, and 15 mg/ft^2 of Triflow Teflon. It was scanned using the contact face plate in November, 1995, and again in June, 1996, after instrument modifications. The results from both studies were analyzed and compared to each other to determine what effect the modifications might have on the results. It appeared that the C-H stretch peak heights (2960 cm-1) were greater in June than they were in November before the modifications. The slope was greater, as well. The results are summarized in Table 18 and Figure 30.

D6AC Steel/CRC Silicone and 7075 Aluminum/CRC Silicone Contamination Standards

Contamination step plates of both D6AC Steel and 7075 Aluminum were prepared with coating levels of 1, 3, 6, 10, and 15 mg/ft2 of CRC Silicone. For this contaminant, it was necessary that a new standard be prepared with the same coating levels for both the November, 1995, and the June, 1996, trials. In November, the standards were scanned by the SOC-400 IR and the spectra analyzed by the SOC software. For the June trial, the standards were both scanned by the SOC-400, but because the instrument was shipped out of state, the spectra were analyzed using Nicolet FT-IR software. Analysis in this way resulted in lower Si-C stretch peak heights in June than November (although with equal slopes) for the Aluminum standard. For the D6AC Steel standard the November peaks were lower from 1 - 3 mg/ft^2 and greater above 6 mg/ft^2. The slope for the November trial was 0.0012, compared to 0.0008 for June. Because these trends were inconsistent with those from the other standards examined, it appears possible that analysis of the peaks using software from another instrument may account for the difference. When the SOC-400 is returned, these spectra will be analyzed using its software. These results are summarized in Table 18 and Figure 31 and 32.

D6AC Steel/Paraffin and 7075 Aluminum/Paraffin Contamination Standards

Contamination step plates of both D6AC Steel and 7075 Aluminum were prepared with coating levels of 1, 3, 6, 10, and 15 mg/ft2. Both standards were scanned using the contact face plate and analyzed in November, 1995. However, in June, only the Aluminum standard could be scanned. The D6AC Steel standard had been destroyed. Another standard was prepared and it, too, was destroyed without being analyzed. Comparison of the results from the November and June trials revealed slightly greater (C-H stretch 2915 cm-1) peak heights in June, with only a slightly steeper slope (see Figure 33).

Analysis of Plastic Computer Disk Storage Boxes

Because we store and ship contamination standards in plastic computer disk boxes, there was concern that the boxes might serve as a source of contamination to the standards. Extracts from a box were made using methyl chloroform and acetone. Both extracts were analyzed using the Nicolet FT-IR, and both were 90% matches as Paraffin. Then standards that had been shipped, heated, and stored for several days in these boxes were analyzed using the SOC-400. Their spectra were analyzed for evidence of paraffin contamination. None was detected. Spectra from these analyses are shown in Figures 34 - 39.

Analysis to Determine Residual Cleaner Contamination

A. Performed SOC-400 IR contact analyses to determine if residual cleaner contamination could be detected on the surface of D6AC steel. Five D6AC specimens were prepared by grit blasting and hand wipe cleaning with 1,1,1-trichloroethane (trich) twice, then grit blasting with virgin media, another hand wipe with trich, and finally vapor degreasing. One specimen was used as a control, with its scan utilized as the background for the remaining four specimens. Brulin 1990 GD, Reveille, PF Degreaser, and Ionox BC were the four cleaners, each applied at use strength to a D6AC specimen. Each cleaner was evenly dispersed over the entire surface of the specimen and allowed to "air dry" overnight. Initial scans showed the Brulin 1990 having a definite characterization, and the other three cleaners showing little definition within their scans. See attached Figure 40. It should be noted that Brulin 1990 is aqueous based, and is not presently used in a hand wipe operation as the other cleaners. Brulin 1990 is also the only cleaner tested that is normally diluted to a ten percent solution for use. This solution is used in the Proceco for cleaning certain hardware, and its in-use temperature is 150° to 175° F (applied at approximately 130 psi), followed by a hot DI water rinse (also 150° to 175° F applied at approximately 50 psi), and a dry cycle using missile grade air.

Figure 41 compares the Brulin 1990 residue on D6AC steel at full strength versus use strength (10% solution of Brulin 1990 in deionized water). No rinse was performed for these scans.

Figure 42 overlays scans of the residue of the Brulin 1990 at full strength and at the 10% solution with another sample exposed to the 10% solution and then manually rinsed with deionized water. Figure 43 is a stacked exhibit of these same scans. One may obviously see the characterization of the Brulin, but an interesting note is dealing with the rinse scan. It appears to be cleaner than the control specimen, which was used as the background scan, thus giving negative peaks. This writer is unsure if this is due to the

Brulin actually "etching" the D6AC steel (probably not), or if the rinsed sample is just that much cleaner than the control sample. The latter is more likely since some questions have been raised as to possible contamination of the trich in the vapor degreaser.

B. While performing each preparatory step prior to testing, an OSEE Generation II scan and a SIM/IR (SOC 400) scan was taken to check for contamination and verify the defined preparatory procedure, which is as follows:

a. Rough grit blast
b. Hand wipe using trich
c. Vapor degrease
d. Final grit blast with virgin media at 20° angle

SIM/IR provided no useful data, but the OSEE II gave some interesting results.

	Average Centivolts	Standard Deviation
After a.	508	33
After c.	251	19
After d.	634	28

Normal values after d (final grit blast) are a minimum 650 cv. Future testing is planned to leave the vapor degrease step out and note if the values after final grit blast are higher.

C. Five D6AC steel tapered double cantilever beams were prepared as shown previously in B. The beams were then tested as follows:

beam 1 = control sample (used as background for SIM/IR)
beam 2 = exposed to full cleaning cycle
beam 3 = exposed to wash cycle only (10% Brulin 1990)
beam 4 = exposed to rinse cycle only (deionized water)
beam 5 = exposed to air dry cycle only (missile grade air)

The first set of beams was tested in the dishwasher system located in Building 4707. Figure 44 provides SIM/IR scans, which were performed on the SOC 400. For comparison, below is average OSEE II data taken immediately prior to SIM/IR.

beam 1	618 centivolts (pre-test)
beam 1	547 centivolts
beam 2	512 centivolts prior to final grit blast
beam 2	655 centivolts after final grit blast
beam 3	0 centivolts
beam 4	409 centivolts
beam 5	669 centivolts

Although the two sets of data obviously agree, the OSEE II seems to be much more sensitive to oxidation which immediately starts accruing, as shown previously with the drop from 618 to 547 cv over a period of approximately one hour. Notice beam 3 has a 0 cv reading. This is due to the residual Brulin 1990, as shown on the SIM/IR scan.

The second set of beams was tested in the Proceco (also located in Building 4707) in the same manner as described above. The Proceco procedure is summarized in the previous section A of this report. Figure 45 provides SIM/IR scans, and OSEE II data is shown below.

beam 1	734 centivolts (pre-test)
beam 1	660 centivolts
beam 2	386 centivolts prior to final grit blast
beam 2	829 centivolts after final grit blast
beam 3	116 centivolts
beam 4	470 centivolts
beam 5	917 centivolts

Again, the SIM/IR scans and the OSEE II data agree. Oxidation is again noticed, and on beam 3, there is residual Brulin 1990 as expected and shown using SIM/IR. An interesting comparison is between the OSEE II data from each set of beams tested. Notice that beam 5 has the highest reading in each set. This is not fully understood, but could be due to the additional blowing off of grit blast dust, since beam 5 was only exposed to the air dry cycle.

Further Analysis of Cleaner Residues

Performed SOC-400 IR contact analyses to determine the signature of residual cleaner contamination. Initially, approximately the same amount of the cleaners (Brulin 1990 GD, Reveille, PF Degreaser, and Ionox BC) were poured into aluminum weighing pans and allowed to come to dryness. The evaporation process was accelerated by placing all the samples and a control (empty pan) on a hot plate set to its lowest setting inside a ventilation hood. The Brulin left a significant amount of solids behind. Since a signature has been previously noted and reported (see Figure 46), the Brulin was not placed in contact with the analyzer head of the SOC-400. The remaining cleaners were tested, giving the results shown in Figure 47. The Ionox sample provided an excellent signature. These results were expected since a small amount of clear visible residue was noted. The Reveille and the PF Degreaser samples provided no signature (within the noise of the instrument baseline) at these concentrations. Further work in this area was performed by allowing approximately 3 times the initial concentration of PF Degreaser and Reveille to come to dryness (air dry- not accelerated) in aluminum weighing pans. These samples again provided no determinable signature in the mid-infrared range (see Figures 48 - 50). It is planned to grit blast the aluminum weighing pans and try again. It is also planned to try again to analyze these samples on the Nicolet FTIR Microscope and the Guided Wave Spectrometer. Figure 51 provides the NIR analysis of the same PF Degreaser sample.

Evaluation of the OSEE III System and 6" Sensors

In January 1996, six OSEE III 6" sensors were received from NASA-Langley for evaluation. Five of the sensors (#1, #3, #5, #7, #8) exhibited unstable lamp output (TP-2) voltages, and were therefore sent back to Langley (excluding #5) for testing. Sensors #1, #7 and #8 were stable on the Langley system, and were returned to MSFC without being modified. Sensor #3 had a faulty lamp, which was replaced prior to being returned to MSFC.

Of the six sensors evaluated, only #2 was successfully calibrated. Plots of responses versus time for grit blasted D6AC steel panels exhibited the expected trends (Figure

52, Table 19), and the TP-2 voltage was stable through approximately 10 hours of use in SCAN mode. The sensor gain settings were adjusted until initial readings from grit blasted steel panels averaged 200-250 counts, which calibrated the response of sensor #2 with that of sensor #4.

OSEE II vs OSEE III: Analysis of 7075-T73 Aluminum

Figure 53 and Table 20 summarize results from an initial analysis of an aluminum panel with sensor #2. The responses averaged 2033 counts immediately after grit blasting, 917 counts after 1 hour, and 581 counts after three hours.

Next, comparative analyses of aluminum were performed with the OSEE II and OSEE III systems. Results from two initial scans of aluminum with the OSEE II system are shown in Table 21 and Figures 54 - 55. Percent signal decreases over time were relatively modest, and averaged 25% six days after the panels were grit blasted. The most dramatic response changes occurred during the first two hours after measurements were initiated, and ranged from 5-10 percent.

Results from two experiments with the OSEE III system are shown in Table 22 and Figures 56 - 58. Signals averaged 2000-2025 counts immediately after panels were grit blasted, 981-1153 counts one hour later, and 652-689 counts after four hours. The percent signal decreases averaged 60% after two hours, which was significantly higher than the 5-10% drop observed for the same time period with the OSEE II. Similarly to the OSEE II, the most significant signal drops were observed during the initial two hours after panels were grit blasted; the signals decreased by only an additional 20-25% over the following eight days.

The data shown in Tables 21 and 22 were collected by examining aluminum panels exclusively on either the OSEE II or OSEE III systems, therefore additional experiments were performed where aluminum plates were shuttled between the two instruments. This procedure eliminated variations possibly resulting from differences in grit blast angles, and provided more accurate comparisons of the response trends. Table 23 shows the results numerically, and Figure 59 shows plots of percent signal decreases versus time. Signal decreases were again significantly more dramatic for the OSEE III, which confirmed that it was more sensitive than the OSEE II to oxidation build-up on aluminum.

Effect of Sensor/Substrate Gap Region Argon Purge on OSEE III Response to 7075-T73 Aluminum

Results from experiments performed to quantify the impact of the argon gas purge on OSEE III analyses of grit blasted aluminum panels are summarized in Table 24 and Figures 60 - 61. Initial responses averaged 316 counts when the purge was turned off, compared to 1992 counts when the argon purge was employed. The percent signal changes over time were significantly less dramatic without argon purging, and were similar to those observed with the OSEE II (Figure 55).

Effect of Sensor/Substrate Gap Region Argon Purge on OSEE III Response to D6AC Steel

The data in Table 25 and Figure 62 show that argon purging of the sensor/substrate gap region also had a significant impact on OSEE III responses obtained from grit blasted D6AC steel. Initial signals with argon flowing to the gap region averaged 225 counts, compared to 97 counts when the purge was not used. However, unlike 7075-T73 aluminum, the percent signal changes over time were similar for the two analysis conditions (Figure 63).

Table 26 and Figures 64 - 65 show comparisons of results from analyses of grit blasted D6AC panels with the OSEE II and OSEE III systems. One experiment was performed without exposing the D6AC panel to argon during analyses with the OSEE III system, and the second experiment was performed with the argon purge turned on. For the durations of the tests (2-3 hours), percent signal changes versus time averaged 5-8% higher for the OSEE III than for the OSEE II. Thus, the OSEE III was slightly more sensitive than the OSEE II to oxidation build-up on D6AC steel during the initial few hours after grit blasting. Exposure to argon gas during analyses with the OSEE III did not significantly impact results obtained with either the OSEE II or OSEE III systems (Figure 66).

Effect of Argon Flow Rate of Sensor/Substrate Gap Region on D6ACSteel Analyses

Table 27 summarizes results from initial experiments to determine the influence of argon flow rate to the sensor/substrate gap region on D6AC steel response trends. The baseline flow rate was 5.4 slpm, as recommended by NASA Langley personnel. Additional flow rates evaluated were 0, 1, 2, 4, 7, 10 and 15 slpm. The scan rate was 1 cm/sec., and the stand-off distance was 1/4". Sensor #8 was used for these experiments.

Figure 67 shows plots of OSEE III response versus time for flow rates of 0 slpm, 1 slpm, and the baseline. Initial responses averaged 126 counts at 0 slpm, which was significantly lower than the 252 counts observed at 5.4 slpm (based on average data collected to date with sensor #8). Initial responses at 1 slpm averaged 204 counts, but response differentials across the six channels were extremely high (up to 119 counts) and indicated that the argon flow was not consistent across the sensor. Plots of percent signal changes versus time were similar at 0 slpm and 5.4 slpm, but results were erratic at 1 slpm. Response changes at 2 slpm (Figure 68) were similar to the baseline results through approximately 50 minutes, but a significant jump from 150 to 180 counts occurred after 80 minutes: Response differentials across the six data channels averaged 24-95 counts, which were higher than the 12-30 count differentials observed at 5.4 slpm. Based on the significant response fluctuations observed with data channels 1-3, it appeared that the argon flow was not consistent across the sensor. The argon purge entered the gap region near channel six., which explained why data from channels 4-6 were typically higher and more consistent that data from channels 1-3.

The most interesting results were obtained at 4 slpm. Responses averaged 167 counts initially after grit blasting, and averaged 162 counts three hours later. Plots of response changes or percent signal changes versus time were essentially flat (Figure 68), which gave the appearance that the panel was not oxidizing. However, the experiment will be repeated before conclusions are formed.

As shown in Figure 69, plots of OSEE III responses versus time were similar for flow rates of 5.4 slpm, 7 slpm, and 10 slpm. No dramatic changes in responses were observed between successive scans, and signal differentials across the six data channels averaged 15-25 counts for all three flow rates/ Trends for percent signal changes over time at 7 slpm and 10 slpm were also similar to the baseline results, although the magnitude of the response changes were approximately 10-15% higher at 5.4 slpm from 30 minutes on.

Initial signals at 15 slpm averaged 167 counts (Figure 69), which was significantly lower than the baseline average of 252 counts. Percent signal changes over time were more modest than those at 5.4 slpm, and averaged only 13% after two hours. These conditions will also be repeated.

Effects of Argon Flow Rate to the Sensor/Substrate Gap Region and Scan Speed on D6AC Steel Analyses

Experiments were conducted to evaluate the effects of argon flow rate to the sensor/substrate gap region and scan speed on response trends for grit blasted D6AC steel panels. Analyses were performed using argon flow rates of 4, 5.4 or 10 slpm and scan speeds of 0.5 or 2 cm/second in continuous scan mode. Stand-off was 1/4". Baseline response trends were generated using a 5.4 slpm argon flow rate and a 1 cm/sec. scan speed.

Figures 70 and 71 summarize results for the 5.4 slpm argon flow rate. Plots of OSEE III responses or percent signal changes versus time were similar for all three scan speeds.

Scan speed did not have a significant impact on D6AC steel response trends when the argon flow rate was 10 slpm (Figures 72 - 73). Plots of counts or percent signal changes overtime were similar to the baseline results.

As shown in Figures 74 and 75, response trends for the two scan speeds were also similar with a 4 slpm argon flow rate. The low initial responses at 0.5 slpm (196 counts) were probably due to the panel's being grit blasted at an angle that was slightly too high (›20 degrees).

Conclusions from Argon Flow Rate and Scan Speed Experiments

Equivalent OSEE III response trends were observed for grit blasted D6AC steel panels when scan speeds from 0.5 - 2 cm/sec. and argon flow rates from 4 - 10 slpm were employed. Argon flow rates less than 4 slpm or greater than 10 slpm resulted in erratic (1 or 2 slpm) or suppressed (0 or 15 slpm) OSEE III signals. For the acceptable argon flow rates, scan speed did not significantly impact analysis results.

Effects of Scan Mode and Scan Speed on D6AC Steel Analyses

Experiments were conducted to evaluate the effects of scan mode (Discrete or Continuous) and scan speed on response trends for grit basted D6AC steel panels. Discrete scans consisting of ten steps of one cm each and five steps of two cm each were performed at scan speeds of 0.5 cm/sec, 1.0 cm/sec, and 2.0 cm/sec. Baseline response trends were generated using a Continuous scan mode (one step of ten cm) and a 1.0 cm/sec. scan speed. All testing was performed using Sensor #2 and argon flow rate of 5.4 slpm at measurement area. The stand-off distance was 1/4". The data are summarized in Table 28 and Figures 76 - 78.

Conclusions from Scan Mode and Scan Speed Experiments

Analysis of the data from this test, indicated the response trends for scan speed 1 (0.5 cm/sec.) more closely resemble those of the Baseline (Continuous mode, 1.0 cm/sec) See Figure 76. Subsequent testing that involved Discrete scanning with both 2 cm and 1 cm steps and scan speeds of 1 cm/sec, and 2 cm/sec. is more difficult to analyze due to the fact that the bulb in the sensor was in the process of "dying", and the data became increasingly erratic. Even the data generated by the Baseline scans tended to be less than typical. Further conclusions on these scan parameters cannot be made without repeating these experiments with stable

"Old " Rack Versus "New" Rack

Participated in a coordinated effort with Thiokol personnel to generate a procedure for bulb replacement in 6" sensors. It was determined that vapor degreasing of the replacement bulb is a necessary prelude to its installation. Apparatus for this process was constructed and utilized prior to installation of bulb currently in Sensor #2. A stable AC voltage was achieved, and it was determined that bulb output is similar to levels accustomed to measuring with Sensor #2. Successfully calibrated Sensor #2 and ran a series of tests with the "Old" familiar Rack to use as baseline for subsequent evaluation of the "New" Rack. Then ran series of tests using Sensor #2 and "New" rack. Data are described in Figures 79 - 85, and Tables 29 - 30. Following that Sensor #8 was callibrated and tests were run with it using the "New" Rack. The data are described in Figures 86 - 88, and Table 31. For the most part, both Racks behave very similarly. Sensor #2 was not able to maintain calibration from one day to the next, even after spending the night in Standby mode. Further analysis and discussion of test data is unavailable at this time due to NASA-authorized change in priority.

Guided Wave Near Infrared Spectrometer

Continued work on the Guided Wave Model 260 Fiber Optic Spectrophotometer. Unlike conventional instruments, this system uses optical fibers to carry light to the sample and then return to the instrument for analysis. This allows for in situ measurement of chemical composition with the instrument remote from the sample, and depending on the configuration chosen, the analyzer may be used from approximately 250 nm in the ultraviolet to 2200 nm in the near infrared.

Near infrared spectroscopy (NIR) is a technology that has been gaining recognition as a viable surface analysis method. NIR has several advantages over mid IR techniques in the on-line analysis of surfaces in a manufacturing environment. The near IR energy can be transmitted over relatively inexpensive silica fiber optics to make the probe accessible to hardware in virtually any setting. Energy is not saturated as easily in the near IR because the absorption bands are actually harmonics of the fundamental mid IR vibrational frequencies. Thus, higher levels of concentration can be monitored without saturation.

Another advantage of NIR is that subtle surface chemistry variations may be detected. For example, hydroxides of aluminum can be detected, and hydrocarbons can be differentiated from silicones. One disadvantage is that the spectra in the near are more difficult to analyze than mid IR spectra because the absorption bands are more spread out, and therefore not easily resolved into functional groups.

NIR is an excellent analytical tool for further evaluating anomalous regions detected by optically stimulated electron emission (OSEE) or some other screening method. All things considered, NIR has outstanding analytical capabilities.

PF Degreaser was evaluated while the NIR instrument was still set up at UAH (refer to Figure 51). It seems that NIR spectra provided more definition to the signature than did mid IR using the SOC-400. The instrument has been moved back to MSFC, and work is being accomplished to set the instrument up for use with the integrating sphere. It has been noted that the instrument will also require further calibration. Further work is in process to verify the method and to compare the NIR to mid IR techniques and data.

5. *Plans:*

1. Upon completion of the installation at MSFC, perform testing of cleaner residues with the Guided Wave Model 260 Fiber Optic Spectrophotometer.

2. Continue utilizing available surface inspection instrumentation for residual contamination testing of both the organic and the ionic (aqueous) based cleaners at production concentrations and following current and proposed production specifications.

3. Perform experimental investigations for the development of contaminant detection, identification, quantification techniques, and evaluation of the effects of these contaminants on system performance.

4. Upon receipt of the one inch OSEE III sensor, characterize its performance on D6AC steel and 7075 aluminum specimens.

Table 1 : RESULTS FROM ANALYSES OF CONTAMINATION STANDARDS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES

Contamination Standard and Peak Location	*Coating Level mg/ft2*	*Avg. Peak Height 16cm-1 Contact Mode*	*Avg. Peak Height 16cm-1, 50 mil gap*	*Avg. Peak Height 16cm-1, KBr Plate*
D6AC/Paraffin, 2915 cm-1	15	0.059	0.064	0.08
	10	0.035	0.032	0.05
	6	0.013	0.016	0.023
	3	0.005	0.006	ND
	1	0.002	ND	ND
Linear Correlation		**0.97**	**0.98**	**0.99**
Slope		**0.0042**	**0.0048**	**0.0064**
7075-T73/Paraffin, 2915 cm-1	15	0.065	0.052	0.094
	10	0.03	0.038	0.062
	6	0.019	0.024	0.042
	3	0.009	0.009	0.021
	1	0.004	0.003	ND
Linear Correlation		**0.95**	**0.99**	**0.99**
Slope		**0.0042**	**0.0036**	**0.0061**
7075-T73/Silicone, 1265 cm-1	15	0.02	0.015	0.036
	10	0.015	0.012	0.027
	6	0.012	0.009	0.023
	3	0.0097	0.007	0.016
	1	0.005	0.003	ND
Linear Correlation		**0.97**	**0.95**	**0.92**
Slope		**0.00099**	**0.0008**	**0.002**
D6AC/Silicone, 1265 cm-1	15	0.015	0.01	0.01
	10	0.008	0.007	ND
	6	0.004	0.003	ND
	3	0.001	0.001	ND
	1	ND	ND	ND
Linear Correlation		**0.98**	**0.99**	**NA**
Slope		**0.0012**	**0.0008**	**NA**
7075-T73/Tri-Flow, 2921 cm-1	15	0.017	0.01	0.023
	10	0.01	0.006	0.018
	6	0.007	0.004	0.01
	3	0.005	0.003	ND
	1	0.003	ND	ND

48 pulses per scan. Peak heights were average of three spectra per coating level. ND=not detected at this level. NA=not applicable. Note: KBr face plate is also contact mode. AC76n/3/96

Table 1: RESULTS FROM ANALYSES OF CONTAMINATION STANDARDS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES

Linear Correlation		**0.98**	**0.97**	**0.97**
Slope		**0.00095**	**0.0006**	**0.0014**
7075-T73/Fluorolube, 1200 cm-1	16	0.009	0.011	0.012
	11	0.006	0.007	0.008
	7	0.003	0.005	0.006
	3	0.002	ND	ND
	1	ND	ND	ND
Linear Correlation		**0.97**	**0.98**	**0.98**
Slope		0.00056	0.00067	0.00067
D6AC/Fluorolube, 1200 cm-1	16	0.014	0.012	0.024
	11	0.008	0.007	0.019
	7	0.0044	0.005	0.014
	3	0.0022	0.002	ND
	1	ND	ND	ND
Linear Correlation		**0.97**	**0.98**	**0.99**
Slope		**0.0009**	**0.00075**	**0.0011**

48 pulses per scan. Peak heights were average of three spectra per coating level. ND=not detected at this level. NA=not applicable. Note: KBr face plate is also contact mode. AC76n/3/96

Table 2 : RESULTS FROM ANALYSES OF CONTAMINATION STANDARDS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES-SIGNAL/NOISE RATIOS

Contamination Standard and Peak Location	*Coating Level mg/ft2*	*S/N Ratio 16cm-1,Contact Mode*	*S/N Ratio 16cm-1, 50 mil gap*	*S/N Ratio 16cm-1, KBr Plate*
D6AC/Paraffin, 2915 cm-1	15	55	22	9
	10	35	15	5
	6	16	9	3
	3	8	4	ND
	1	2	ND	ND
7075-T73/Paraffin, 2915 cm-1	15	52	43	14
	10	43	29	11
	6	33	21	7
	3	12	7	4
	1	4	2	ND
7075-T73/Silicone, 1265 cm-1	15	40	15	6
	10	34	9	5
	6	16	4	4
	3	7	3	3
	1	2	2	ND
D6AC/Silicone, 1265 cm-1	15	16	7	2
	10	12	6	ND
	6	4	2	ND
	3	3	2	ND
	1	ND	ND	ND
7075-T73/Tri-Flow, 2921 cm-1	15	25	11	4
	10	23	7	3
	6	8	3	2
	3	5	3	ND
	1	3	ND	ND
7075-T73/Fluorolube, 1200 cm-1	16	20	10	4
	11	14	5	3
	7	7	4	2
	3	3	ND	ND
	1	ND	ND	ND
D6AC/Fluorolube, 1200 cm-1	16	22	21	5
	11	10	13	4
	7	5	6	3
	3	3	2	ND
	1	ND	ND	ND

48 pulses per scan. Peak heights were average of three spectra per coating level. ND=not detected at this level. Note:KBr face plate also contact mode. AC76o/3/96

Table 3 : ESTIMATED DETECTION/QUANTIFICATION LIMITS WITH THE FT-IR MICROSCOPE; SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES

Substrate	*Coating*	*FT-IR Microscope 16cm-1 resolution*	*SIMIR Contact, 16cm-1*	*SIMIR 16cm-1, 50 mil gap*	*SIMIR 16cm-1, KBr Plate*
7075-T73	Paraffin	5-8 mg/ft2	2-3 mg/ft2	2-3 mg/ft2	4-5 mg/ft2
7075-T73	CRC Silicone	25-30 mg/ft2	2-3 mg/ft2	6-8 mg/ft2	6-8 mg/ft2
7075-T73	Tri-Flow	15-20 mg/ft2	2-4 mg/ft2	6-8 mg/ft2	12-15 mg/ft2
7075-T73	Fluorolube	>16 mg/ft2	4-5 mg/ft2	6-7 mg/ft2	11-13 mg/ft2
D6AC	Paraffin	5-8 mg/ft2	2-3 mg/ft2	3-5 mg/ft2	7-9 mg/ft2
D6AC	CRC Silicone	15-17 mg/ft2	6-8 mg/ft2	8-10 mg/ft2	>15 mg/ft2
D6AC	Fluorolube	>16 mg/ft2	4-6 mg/ft2	5-6 mg/ft2	8-10 mg/ft2

48 pulses per scan.
Substrates grit blasted at 20 degrees with Zirclean prior to application of coatings.
Quantification/detection limits were estimated based on S/N ratios of IR spectra, where the rule of thumb was that a spectral features intensity must be at least 3 times that of baseline noise to be considered accurately measurable.
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Table 4 : PERCENT SIGNAL REACHING SIMIR DETECTOR WITH THE THREE FACE PLATES

SIMIR Set-Up	*Gold Standard*	*7075-T73 Aluminum*	*D6AC Steel*
KBR Face Plate, Contact Mode	10-11%	7-8%	5-6%
20 mil Stand-Off	38-40%	33-35%	23-25%
50 mil Stand-Off	48-50%	48-50%	30-33%
Contact Mode	48-50%	43-47%	30-33%

Aluminum and D6AC specimens grit blasted with Zirclean media. Instrument parameters: 32 cm-1 resolution, autogain. AC75y/2/96

Table 5 : COMPARISON OF RESULTS FROM ANALYSES OF CONTAMINATION STANDARDS WITH THE SIMIR CONTACT AND NON-CONTACT FACE PLATES-PEAK HEIGHTS (ABSORBANCE) VERSUS COATING LEVELS

Contamination Standard and Peak Location	*Coating Level mg/ft2*	*Avg. Peak Height Contact Mode*	*Avg. Peak Height 16cm-1, 50 mil gap*	*Avg. Peak Height 32cm-1, 50 mil gap*	*Avg. Peak Height 16cm-1, 20 mil gap*	*Avg. Peak Height 32cm-1, 20 mil gap*
D6AC/Paraffin, 2915 cm-1	15	0.059	0.064	0.047	0.078	0.06
	10	0.035	0.032	0.029	0.032	0.02
	6	0.013	0.016	0.01	0.015	0.009
	3	0.005	0.006	0.005	0.006	0.006
	1	0.002	ND	ND	ND	ND
Linear Correlation		**0.97**	**0.98**	**0.98**	**0.94**	**0.88**
Slope		**0.0042**	**0.0048**	**0.004**	**0.0059**	**0.0045**
7075-T73/Paraffin, 2915 cm-1	15	0.065	0.052	0.034	0.055	0.05
	10	0.03	0.038	0.022	0.03	0.026
	6	0.019	0.024	0.014	0.014	0.012
	3	0.009	0.009	0.009	0.01	0.005
	1	0.004	0.003	0.002	ND	ND
Linear Correlation		**0.95**	**0.99**	**0.99**	**0.96**	**0.98**
Slope		**0.0042**	**0.0036**	**0.0022**	**0.0039**	**0.0038**
7075-T73/Silicone, 1265 cm-1	15	0.02	0.015	0.01	0.02	0.011
	10	0.015	0.012	0.008	0.015	0.01
	6	0.012	0.009	0.005	0.013	0.007
	3	0.0097	0.007	0.004	0.01	0.003
	1	0.005	0.003	0.002	0.004	0.002
Linear Correlation		**0.97**	**0.95**	**0.98**	**0.92**	**0.92**
Slope		**0.0001**	**0.0008**	**0.0006**	**0.001**	**0.001**
D6AC/Silicone, 1265 cm-1	15	0.015	0.01	0.005	0.01	0.008
	10	0.008	0.007	0.005	0.007	0.004
	6	0.004	0.003	0.004	0.004	0.002

48 pulses per scan. Peak heights were average of three spectra per coating level. ND=not detected at this level. Contact mode analyses were performed at 16cm-1 resolution. AC75n/2/96

Table 5 : COMPARISON OF RESULTS FROM ANALYSES OF CONTAMINATION STANDARDS WITH THE SIMIR CONTACT AND NON-CONTACT FACE PLATES-PEAK HEIGHTS (ABSORBANCE) VERSUS COATING LEVELS

	3	0.001	0.001	ND	ND	ND
	1	ND	ND	ND	ND	ND
Linear Correlation		**0.98**	**0.99**	**0.7**	**0.99**	**0.98**
Slope		**0.0012**	**0.0008**	**0.0001**	**0.0007**	**0.0007**
7075-T73/Tri-Flow, 2921 cm-1	15	0.017	0.01	0.009	0.01	0.008
	10	0.01	0.006	0.006	0.007	0.005
	6	0.007	0.004	0.003	0.002	0.002
	3	0.005	0.003	0.002	ND	ND
	1	0.003	ND	ND	ND	ND
Linear Correlation		**0.98**	**0.97**	**0.99**	**0.96**	**0.99**
Slope		**0.001**	**0.0006**	**0.0006**	**0.0009**	**0.0007**

48 pulses per scan. Peak heights were average of three spectra per coating level. ND=not detected at this level. Contact mode analyses were performed at 16cm-1 resolution. AC75n/2/96

Table 6 : COMPARISON OF RESULTS FROM ANALYSES OF CONTAMINATION STANDARDS WITH THE SIMIR CONTACT AND NON-CONTACT FACE PLATES-SIGNAL/NOISE RATIOS

Contamination Standard and Peak Location	*Coating Level mg/ft2*	*S/N Ratio Contact Mode*	*S/N Ratio 16cm-1, 50 mil gap*	*S/N Ratio 32cm-1, 50 mil gap*	*S/N Ratio 16cm-1, 20 mil gap*	*S/N Ratio 32cm-1, 20 mil gap*
D6AC/Paraffin, 2915 cm-1	15	55	22	20	50	18
	10	35	15	18	20	8
	6	16	9	13	8	6
	3	8	4	3	4	2
	1	2	ND	ND	ND	ND
7075-T73/Paraffin, 2915 cm-1	15	52	43	18	31	15
	10	43	29	16	16	10
	6	33	21	12	8	8
	3	12	7	7	4	4
	1	4	2	3	ND	ND
7075-T73/Silicone, 1265 cm-1	15	40	15	14	14	13
	10	34	9	11	10	10
	6	16	4	5	8	4
	3	7	3	3	4	3
	1	2	2	2	2	2
D6AC/Silicone, 1265 cm-1	15	16	7	16	5	9
	10	12	6	7	3	5
	6	4	2	3	2	3
	3	3	2	ND	ND	ND
	1	ND	ND	ND	ND	ND
7075-T73/Tri-Flow, 2921 cm-1	15	25	11	7	8	8
	10	23	7	6	6	5
	6	8	3	3	2	2
	3	5	3	2	ND	ND
	1	3	ND	ND	ND	ND

48 pulses per scan. Peak heights were average of three spectra per coating level. ND=not detected at this level. Contact mode analyses were performed at 16cm-1 resolution. AC75o/2/96

Table 7 : COMPARISON OF CONTAMINATION STANDARD ANALYSIS RESULTS WITH THE FT-IR MICROSCOPE, SIMIR CONTACT AND NON-CONTACT FACE PLATES-ESTIMATED DETECTION/QUANTIFICATION LIMITS

Substrate	*Coating*	*FT-IR Microscope 16cm-1 resolution*	*SIMIR Contact, 16cm-1*	*SIMIR 16cm-1, 50 mil gap*	*SIMIR 32cm-1, 50 mil gap*	*SIMIR 16cm-1, 20 mil gap*	*SIMIR 32cm-1, 20 mil gap*
7075-T73	Paraffin	5-8 mg/ft2	2-3 mg/ft2	2-3 mg/ft2	2-3 mg/ft2	3-4 mg/ft2	3-4 mg/ft2
7075-T73	CRC Silicone	25-30 mg/ft2	2-3 mg/ft2	6-8 mg/ft2	5-7 mg/ft2	3-5 mg/ft2	6-8 mg/ft2
7075-T73	Tri-Flow	15-20 mg/ft2	2-4 mg/ft2	6-8 mg/ft2	7-9 mg/ft2	8-9 mg/ft2	8-10 mg/ft2
D6AC	Paraffin	5-8 mg/ft2	2-3 mg/ft2	3-5 mg/ft2	4-5 mg/ft2	3-4 mg/ft2	4-6 mg/ft2
D6AC	CRC Silicone	15-17 mg/ft2	6-8 mg/ft2	8-10 mg/ft2	8-10 mg/ft2	11-13 mg/ft2	8-10 mg/ft2

48 pulses per scan.

Substrates grit blasted at 20 degrees with Zirclean prior to application of coatings.

Quantification/detection limits were estimated based on S/N ratios of IR spectra, where the rule of thumb was that a spectral features intensity must be 3 times that of baseline noise to be considered accurately measurable.

AC75p/2/96

Table 8 : Analysis of Gasket/Silicone Contamination Standard

Contam. Standard Target Thickness micrometers	*Line Space from Microscope*	*Index of Refraction*	*Calculated Coating Thickness micrometers*
40	26	1.38	44
		1.22	37
30	18	1.38	30
		1.22	25
20	11	1.38	19
		1.22	16
10	7	1.38	12
		1.22	10

Table 9 : Analysis of Gasket/Silicone From Manufacturer

Gasket Position #	*Line Space from Microscope*	*Index of Refraction*	*Calculated Coating Thickness micrometers*
1	26	1.38	43
		1.22	37
2	24	1.38	40
		1.22	34
3	22	1.38	37
		1.22	31
4	26	1.38	43
		1.22	37
5	21	1.38	35
		1.22	30
6	21	1.38	35
		1.22	30
7	25	1.38	42
		1.22	35
8	22	1.38	37
		1.22	31
9	17	1.38	28
		1.22	24

1.38 index of refraction based on literature values for typical silicones. 1.22 index of refraction based on measured coating thickness using caliper. Formula for calculations:
Thickness=microscope line space X (sqrt 2(index of refraction)2 -1). AC74s/1/96

Table 10: RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/PARAFFIN CONTAMINATION STANDARDS

Panel Roughness Ra, microinches	*Coating Level mg/ft2*	*Average Peak Height 2915 cm-1,Absorbance*	*Regression Height Absorbance*
106, all data	10	0.021	0.019
	15	0.045	0.049
	20	0.074	0.077
	25	0.103	0.104
	30	0.14	0.132
	35	0.159	0.16
	40	0.19	0.188
	44	0.21	0.21
	49	0.247	0.238
	54	0.256	0.266
	63	0.27	0.304
	68	0.3	0.331
	73	0.345	0.357
	78	0.383	0.384
	83	0.398	0.41
	87	0.433	0.431
	92	0.483	0.458
	97	0.505	0.485
Corr. Coefficient		**0.99**	
Slope		**0.006**	
106, initial application of wax to panel	10	0.021	0.021
	15	0.045	0.048
	20	0.074	0.076
	25	0.103	0.104
	30	0.14	0.132
	35	0.159	0.16
	40	0.19	0.188
	44	0.21	0.21
	49	0.247	0.238
	54	0.216	0.266
Corr. Coefficient		0.99	
Slope		0.006	
106, first overspray with additional wax	63	0.27	0.269
	68	0.3	0.304
	73	0.345	0.339
	78	0.383	0.375
	83	0.398	0.409
	87	0.433	0.438
	92	0.483	0.473

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
AC80a/6/96

Table 10 : RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/PARAFFIN CONTAMINATION STANDARDS

	97	0.505	0.508
Corr. Coefficient		**0.99**	
Slope		**0.007**	
230, all data	4	0.01	-0.01
	8	0.014	0.004
	12	0.02	0.018
	19	0.025	0.044
	24	0.039	0.062
	28	0.067	0.076
	33	0.096	0.094
	39	0.104	0.12
	44	0.137	0.13
	49	0.175	0.15
Corr. Coefficient		**0.93**	
Slope		**0.003**	
230, based on apparent slope changes	4	0.01	0.01
	8	0.014	0.014
	12	0.02	0.019
	19	0.025	0.026
Corr. Coefficient		**0.98**	
Slope		**0.001**	
	19	0.025	0.021
	24	0.039	0.045
	28	0.067	0.064
	33	0.096	0.088
	39	0.104	0.117
	44	0.137	0.142
	49	0.175	0.166
Corr. Coefficient		**0.98**	
Slope		**0.005**	
Baseline, 116 6.5" X 6.5" panel	1	0.004	0.00006
	3	0.009	0.009
	6	0.019	0.021
	10	0.03	0.038
	15	0.065	0.059
Corr. Coefficient		**0.95**	
Slope		**0.004**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
AC80a/6/96

Table 11 : RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS

Panel Roughness Ra, microinches	*Coating Level mg/ft2*	*Average Peak Height 1265 cm-1, Absorbance*	*Regression Height Absorbance*
110, all data	4	0.004	0
	9	0.007	0.006
	14	0.013	0.012
	20	0.016	0.019
	25	0.021	0.024
	30	0.024	0.03
	34	0.033	0.036
	40	0.046	0.043
	45	0.05	0.049
	50	0.058	0.054
Corr. Coefficient		**0.96**	
Slope		**0.001**	
110, based on apparent slope changes	4	0.004	0.004
	9	0.007	0.008
	14	0.013	0.011
	20	0.016	0.017
	25	0.021	0.02
	30	0.024	0.024
Corr. Coefficient		**0.99**	
Slope		**0.0008**	
	30	0.024	0.025
	34	0.033	0.033
	40	0.046	0.043
	45	0.05	0.051
	50	0.058	0.059
Corr. Coefficient		**0.98**	
Slope		**0.002**	
168	16	0.005	0.007
	21	0.009	0.009
	26	0.013	0.011
	31	0.015	0.014
	36	0.016	0.017
	40	0.019	0.019
	45	0.023	0.021
	49	0.025	0.023
	55	0.025	0.026
	61	0.027	0.029

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
AC80d/6/96

Table 11: RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS

Corr. Coefficient		**0.96**	
Slope		**0.0005**	
Baseline, 115	1	0.004	0.005
6.5" X 6.5" panel	3	0.007	0.007
	6	0.01	0.009
	10	0.014	0.013
	15	0.018	0.018
Corr. Coefficient		**0.98**	
Slope		**0.001**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
AC80d/6/96

Table 12: RESULTS FROM SOC-400 NON-CONTACT ANALYSES OF ALUMINUM/FLUOROLUBE CONTAMINATION STANDARDS

Panel Size Ra, microinches	*Coating Level mg/ft2*	*Average Peak Height 2915 cm-1, Absorbance*	*Regression Height Absorbance*
4.5" X 4.5", Ra=95	10	0.028	0.071
One coating level per panel	21	0.076	0.108
All data together	33	0.135	0.149
	39	0.169	0.169
	50	0.229	0.207
	62	0.252	0.248
	70	0.312	0.275
	81	0.335	0.313
	93	0.375	0.354
	101	0.403	0.381
	112	0.423	0.419
	124	0.466	0.459
	131	0.512	0.484
	141	0.518	0.517
	153	0.562	0.558
	160	0.579	0.582
	171	0.589	0.619
	183	0.619	0.661
	190	0.63	0.594
	200	0.642	0.607
	213	0.679	0.637
	231	0.719	0.679
	241	0.743	0.703
	253	0.762	0.732
	259	0.768	0.745
	269	0.779	0.768
	281	0.799	0.798
	288	0.809	0.815
	298	0.824	0.838
	311	0.851	0.868
	320	0.88	0.889
	330	0.914	0.912
	342	0.946	0.941
	352	0.955	0.964
	362	0.969	0.987
	374	0.973	1.02
	381	0.978	1.03
	391	0.994	1.06
	404	1.01	1.09
Correlation Coefficient		**0.97**	
Slope		0.0024	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of five spectra per coating level.
AC80m/6/96

Table 12: RESULTS FROM SOC-400 NON-CONTACT ANALYSES OF ALUMINUM/FLUOROLUBE CONTAMINATION STANDARDS

4.5" X 4.5", Ra=95	10	0.028	0.071
One coating level per panel	21	0.076	0.108
Based on apparent	33	0.135	0.149
slope changes	39	0.169	0.169
	50	0.229	0.207
	62	0.252	0.248
	70	0.312	0.275
	81	0.335	0.313
	93	0.375	0.354
	101	0.403	0.381
	112	0.423	0.419
	124	0.466	0.459
	131	0.512	0.484
	141	0.518	0.517
	153	0.562	0.558
	160	0.579	0.582
	171	0.589	0.599
	183	0.619	0.624
Correlation Coefficient		**0.98**	
Slope		**0.0034**	
	190	0.63	0.638
	200	0.642	0.656
	213	0.679	0.679
	231	0.719	0.713
	241	0.743	0.731
	253	0.762	0.754
	259	0.768	0.763
	269	0.779	0.782
	281	0.799	0.806
	288	0.809	0.818
	298	0.824	0.836
	311	0.851	0.86
	320	0.88	0.877
	330	0.914	0.895
	342	0.946	0.917
	352	0.955	0.935
	362	0.969	0.953
	374	0.973	0.976
	381	0.978	0.989
	391	0.994	1.01
	404	1.01	1.03
Correlation Coefficient		**0.99**	
Slope		**0.0018**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of five spectra per coating level.
AC80m/6/96

Table 13 : RESULTS FROM SOC-400 ANALYSES OF ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS

Panel Size Ra, microinches	*Coating Level mg/ft2*	*Average Peak Height 1265 cm-1,Absorbance*	*Regression Height Absorbance*
8" X 11", Over-sprayed	4	0.004	0
Step Plate, Ra=110	9	0.007	0.006
Contact Analyses	14	0.013	0.012
	20	0.016	0.019
	25	0.021	0.024
	30	0.024	0.03
	34	0.033	0.036
	40	0.046	0.043
	45	0.05	0.049
	50	0.058	0.054
Panel Over-sprayed			
	44	0.016	ND
	49	0.021	ND
	54	0.025	ND
	59	0.037	ND
	64	0.041	ND
	69	0.05	ND
	74	0.06	ND
	80	0.086	ND
	85	0.11	ND
	90	0.12	ND
Panel Over-sprayed			
	96	0.055	ND
	101	0.066	ND
	106	0.078	ND
	110	0.11	ND
	116	0.13	ND
	121	0.141	ND
	126	0.171	ND
	131	0.22	ND
	136	0.252	ND
	141	0.25	ND
Panel Over-sprayed			
	146	0.13	ND
	150	0.133	ND
	156	0.156	ND
	161	0.19	ND
	166	0.212	ND
	171	0.243	ND
	176	0.296	ND
	181	0.35	ND

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
ND= Not Determined. AC80I/6/96

Table 13: RESULTS FROM SOC-400 ANALYSES OF ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS

	186	0.36	ND
	191	0.365	ND
4.5" X 4.5", one coating level per panel, Ra=95, all data. Contact analyses.	12	0.015	-0.01
	22	0.031	0.019
	31	0.041	0.044
	48	0.069	0.093
	58	0.08	0.122
	67	0.143	0.148
	79	0.146	0.183
	89	0.167	0.212
	98	0.226	0.238
	126	0.284	0.318
	136	0.289	0.347
	149	0.41	0.384
	158	0.393	0.41
	168	0.396	0.438
	181	0.536	0.476
	198	0.563	0.525
	208	0.54	0.554
	221	0.619	0.591
	229	0.634	0.614
	239	0.696	0.643
	252	0.722	0.68
	269	0.809	0.729
	279	0.802	0.758
	292	0.796	0.795
	301	0.842	0.821
	311	0.879	0.849
	324	0.906	0.887
	336	0.934	0.921
	346	0.984	0.95
	359	0.103	0.987
	377	0.999	1.04
	387	1.05	1.07
	400	1.1	1.11
	423	1.17	1.71
	433	1.12	1.19
	446	1.14	1.24
Correlation Coefficient		**0.98**	
Slope		**0.003**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
ND= Not Determined. AC80I/6/96

Table 13 : RESULTS FROM SOC-400 ANALYSES OF ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS

4.5" X 4.5", one coating	423	0.97	0.99
level per panel, Ra=95,	433	1.03	1.03
Non-contact analyses.	446	1.06	1.08
	466	1.18	1.15
	476	1.21	1.19
	489	1.26	1.23
	504	1.25	1.29
	514	1.32	1.33
	527	1.37	1.37
Correlation Coefficient		**0.97**	
Slope		0.0036	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
ND= Not Determined. AC80I/6/96

Table 14 : RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/FLUOROLUBE CONTAMINATION STANDARDS

Panel Roughness Ra, microinches	*Coating Level mg/ft2*	*Average Peak Height 1200 cm-1,Absorbance*	*Regression Height Absorbance*
112, all data	16	0.006	-0.025
	21	0.007	-0.0198
	27	0.009	-0.0132
	32	0.01	-0.0076
	38	0.012	-0.0009
	43	0.015	0.0046
	48	0.019	0.01
	54	0.022	0.017
	58	0.023	0.021
	61	0.026	0.025
	71	0.028	0.036
	77	0.031	0.042
	82	0.032	0.048
	88	0.039	0.055
	93	0.045	0.06
	98	0.049	0.066
	104	0.061	0.072
	108	0.057	0.077
	114	0.065	0.083
	141	0.087	0.113
	146	0.092	0.119
	152	0.1	0.123
	157	0.12	0.131
	163	0.12	0.138
	168	0.14	0.143
	173	0.14	0.152
	179	0.16	0.16
	183	0.15	0.167
	189	0.17	0.169
	221	0.22	0.202
	230	0.23	0.212
	235	0.24	0.218
	240	0.25	223
	245	0.26	229
	250	0.25	ND
	255	0.25	ND
	261	0.26	ND
	266	0.25	ND
Corr. Coefficient		**0.94**	
Slope		**0.011**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
AC80i/6/96

Table 14: RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/FLUOROLUBE CONTAMINATION STANDARDS

112, based on apparent slope changes	16	0.006	0.005
	21	0.007	0.007
	27	0.009	0.009
	32	0.01	0.011
	38	0.012	0.014
	43	0.015	0.016
	48	0.019	0.018
	54	0.022	0.021
	58	0.023	0.023
	61	0.026	0.024
	71	0.028	0.028
	77	0.031	0.031
	82	0.032	0.033
Corr. Coefficient		**0.98**	
Slope		**0.0004**	
	82	0.032	0.033
	88	0.039	0.04
	93	0.045	0.045
	98	0.049	0.049
	104	0.061	0.055
	108	0.057	0.059
	114	0.065	0.064
	141	0.087	0.089
	146	0.092	0.093
Corr. Coefficient		**0.99**	
Slope		**0.0009**	
	152	0.1	0.107
	157	0.12	0.115
	163	0.12	0.125
	168	0.14	0.133
	173	0.14	0.141
	179	0.16	0.151
	183	0.15	0.157
	189	0.17	0.167
	221	0.22	0.219
	230	0.23	0.233
	235	0.24	0.242
	240	0.25	0.249
	245	0.26	0.258
Corr. Coefficient		**0.99**	
Slope		**0.002**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
AC80i/6/96

Table 14 : RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/FLUOROLUBE CONTAMINATION STANDARDS

155	9	0.004	0.006
	14	0.007	0.007
	19	0.01	0.009
	24	0.011	0.01
	30	0.013	0.012
	35	0.015	0.014
	40	0.014	0.015
	45	0.017	0.017
	51	0.019	0.019
	56	0.019	0.02
Corr. Coefficient		0.96	
Slope		**0.0003**	
Baseline, 114	1	ND	ND
	3	0.002	0.002
	7	0.004	0.004
	11	0.006	0.005
	16	0.008	0.008
Corr. Coefficient		**0.99**	
Slope		**0.0005**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level.
AC80i/6/96

Table 15 : COMPARISON OF SOC-400 CONTACT ANALYSIS RESULTS FROM ALUMINUM PANELS COATED WITH TRI-FLOW, PARAFFIN OR CRC SILICONE

Step Plate	*Coating Level mg/ft2*	*Avg. Peak Hts. Dec-95*	*Regression Peak Hts. Dec-95*	*Avg. Peak Hts. May-96*	*Regression Peak Hts. May-96*
Aluminum/paraffin	15	0.065	0.059	0.06	0.059
	10	0.03	0.038	0.038	0.039
	6	0.019	0.021	0.024	0.023
	3	0.009	0.009	0.01	0.01
	1	0.004	6 x 10-5	0.003	0.003
Correlation Coefficient		**0.95**		**0.99**	
Slope		**0.0042**		**0.004**	
Aluminum/CRC Silicone	15	0.021	0.02	0.022	0.023
	10	0.015	0.016	0.017	0.017
	6	0.012	0.012	0.014	0.012
	3	0.01	0.009	0.009	0.008
	1	0.005	0.007	0.004	0.006
Correlation Coefficient		**0.97**		**0.95**	
Slope		**0.0009**		**0.0011**	
Aluminum/Tri-Flow	15	0.017	0.016	0.016	0.015
	10	0.01	0.011	0.009	0.011
	6	0.007	0.008	0.008	0.007
	3	0.005	0.005	0.005	0.005
	1	0.003	0.003	0.003	0.003
Correlation Coefficient		**0.98**		**0.96**	
Slope		**0.001**		**0.001**	

Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. Peak heights are in Absorbance units. AC80p/6/96

Table 16: SOC-400 SIGNAL/NOISE RATIO FOR PARAFFIN OVER 7075 ALUMINUM BEFORE AND AFTER INSTRUMENT MODIFICATIONS

	March 1996		June 1996	
Coating Level Mg/ft2	Signal/Noise Ratio	Regression S/N Ratio	Signal/Noise Ratio	Regression S/N Ratio
6	N/A	N/A	5	12
9-10	12	28	15	17
14-15	23	33	23	25
19-20	50	37	35	33
24-25	51	41	50	40
29-30	55	45	55	48
34-35	64	49	57	56
39-40	57	54	65	64
44-45	41	57	65	73
49-50	52	61	78	81
54	65	65	N/A	N/A
Correlation	.51		.94	
Slope	0.8359		1.5558	

Parameters: Absorbance, 48 pulses per spectra, 16 cm-1 resolution. Results are averages of three spectra per coating level. March Ra: 110 micro-inches. June Ra: 101 micro-inches.

Table 17: SOC-400 CONTACT ANALYSIS OF ROUGHNESS EFFECT FOR PARAFFIN OVER 7075 ALUMINUM

Roughness 62 micro-inches:

Coating mg/ft^2	Peak Height	Regression	Signal/Noise
1	0.0361	0.0108	9.5
22	0.1004	0.0986	25.1
32	0.1358	0.1864	40.2
42	0.2914	0.2742	59.2
52	0.3739	0.3620	96.1
R^2	0.96		0.96
Slope	0.0088		2.07

Roughness 101 micro-inches:

Coating mg/ft^2	Peak Height	Regression	Signal/Noise
6	0.0129	0.0084	4.5
9	0.0331	0.0277	14.8
14	0.0632	0.0599	23.3
19	0.0797	0.0921	35.4
24	0.1054	0.1243	50.2
29	0.1590	0.1565	55.1
34	0.1992	0.1887	57.0
39	0.2356	0.2209	65.1
45	0.2524	0.2596	65.3
50	0.2897	0.2918	77.7
R^2	0.99		0.94
slope	0.0064		1.56

Roughness 172 micro-inches:

Coating mg/ft^2	Peak Height	Regression	Signal/Noise
9	0.0162	0.0060	10.2
20	0.0387	0.0434	20.7
30	0.0830	0.0889	38.4
40	0.1305	0.1284	63.7
50	0.1721	0.1678	81.2
R^2	0.98		0.98
Slope	0.0037		1.67

Parameters: 48 pulses per spectrum, 16 cm^{-1} resolution. Results are averages of three (min) spectra per coating level.

Table 18: SOC-400 CONTACT ANALYSIS OF ALUMINUM AND D6AC STEEL CONTAMINATION STANDARDS BEFORE AND AFTER INSTRUMENT MODIFICATIONS

Aluminum/Fluorolube, 1200 cm-1

Coating Level Mg/ft^2	Peak Height June '96	Regression June '96	Peak Height Feb. '96	Regression Feb. '96
1	ND	ND	ND	ND
3	0.0018	0.0017	0.002	0.002
7	0.0047	0.0037	0.004	0.004
11	0.0056	0.0058	0.006	0.006
16	0.0082	0.0084	0.008	0.008
R^2	0.99		0.99	
Slope	0.0005		0.0005	

D6AC Steel/Fluorolube, 1200 cm-1

Coating Level Mg/ft^2	Peak Height June '96	Regression June '96	Peak Height Feb. '96	Regression Feb. '96
1	0.0023	0.0024	ND	ND
3	0.0041	0.0040	0.0022	0.0014
7	0.0072	0.0073	0.0044	0.0050
11	0.0105	0.0105	0.0080	0.0087
16	0.0146	0.0146	0.0140	0.0133
R^2	0.99+		0.97	
Slope	0.0008		0.0009	

Aluminum/Teflon, 2920 cm-1

Coating Level Mg/ft^2	Peak Height June '96	Regression June '96	Peak Height Nov. '95	Regression Nov. '95
1	0.0047	0.0033	0.0029	0.0027
3	0.0060	0.0062	0.0049	0.0046
6	0.0087	0.0105	0.0074	0.0075
10	0.0160	0.0162	0.0103	0.0113
15	0.0241	0.0233	0.0166	0.0160
R^2	0.98		0.99	
Slope	0.0014		0.00095	

Aluminum/CRC Silicone, 1265 cm-1

Coating Level Mg/ft^2	Peak Height June '96	Regression June '96	Peak Height Nov. '95	Regression Nov. '95
1	0.0016	0.0023	0.0053	0.0065
3.5	0.0060	0.0053	0.0097	0.0085
6.5	0.0082	0.0082	0.0122	0.0115

Aluminum/CRC Silicone, 1265 cm-1 (continued)

Coating Level Mg/ft^2	Peak Height June '96	Regression June '96	Peak Height Nov. '95	Regression Nov. '95
10.5	0.0125	0.0121	0.0148	0.0155
15	0.0155	0.0160	0.0205	0.0200
R^2	0.99		0.97	
Slope	0.0010		0.0010	

D6AC Steel/CRC Silicone, 1265 cm-1

Coating Level Mg/ft^2	Peak Height June '96	Regression June '96	Peak Height Nov. '95	Regression Nov. '95
1	0.0009	0.0007	ND	ND
3.5	0.0030	0.0030	0.0012	0.00064
6.5	0.0046	0.0053	0.0038	0.0041
10.5	0.0089	0.0083	0.0081	0.0088
15	0.0112	0.0113	0.0152	0.0147
R^2	0.99		0.98	
Slope	0.0008		0.0012	

Aluminum/Paraffin, 2915 cm-1

Coating Level Mg/ft^2	Peak Height June '96	Regression June '96	Peak Height Nov. '95	Regression Nov. '95
1	0.0017	0.0017	0.0038	0.0006
3	0.0096	0.0109	0.0090	0.0085
6	0.0270	0.0246	0.0190	0.0211
10	0.0417	0.0429	0.0300	0.0380
15	0.0658	0.0657	0.0648	0.0590
R^2	0.99+		0.95	
Slope	0.0046		0.0042	

D6AC Steel/Paraffin, 2915 cm-1

Standard Distroyed. Instrument unavailable.

Parameters: Absorbance, 48 pulses per spectrum, 16 cm-1 resolution. Results are averages of three spectra per coating level. All "Before" and "After" results were obtained from the same standard (original coating) except for Silicone, which required new standards in June. Also, the spectra obtained from Silicone by the SOC-400 were analyzed using Nicolet IR software.

Table 19: RESULTS FROM ANALYSES OF D6AC STEEL PANELS WITH OSEE III 6" SENSOR #2

Time Minutes	*C1-C6 Avg. Counts Trial #1*	*Diff. Between Channels Trial #1*	*C1-C6 Avg. Counts Trial #2*	*Diff. Between Channels Trial #2*
0	246	15	234	21
10	176	21	185	15
20	177	19	174	15
30	172	21	159	13
40	177	16	163	15
50	178	15	157	12
60	174	18	157	14
80	167	18	153	16
100	167	23	150	14
120	171	12	145	14
140	170	13	NA	NA
160	172	16	NA	NA
180	172	14	138	11
250	NA	NA	118	7
280	NA	NA	108	7
310	NA	NA	103	6
340	NA	NA	99	5
370	NA	NA	94	4
400	NA	NA	98	5

Continuous scanning mode, 1/4" stand-off distance, scan speed 4. Grit blast angle 20 degrees.
AC74u/1/96

Table 20: RESULTS FROM ANALYSES OF 7075-T73 ALUMINUM WITH OSEE III 6" SENSOR #2

Time Minutes	*Average Response Counts*	*Diff. Between Channels*	*Percent Original Signal*
0	2033	15	100
10	1475	58	73
20	1247	82	61
30	1112	81	55
40	1043	86	51
50	936	91	46
60	917	90	45
80	803	93	39
100	724	98	36
120	672	100	33
180	581	109	29

Continuous scanning mode, 1/4" stand-off distance, scan speed 4. Grit blast angle 20 degrees.
AC74t/1/96

Table 21: RESULTS FROM ANALYSES OF GRIT BLASTED ALUMINUM PANELS WITH OSEE II

Time	Mean cV Trial 1	% Initial Signal Trial 1	Mean cV Trial 2	% Initial Signal Trial 2
0 min.	ND	ND	2391	100
5 min.	2023	100	2385	99
10 min.	ND	ND	2375	99
15 min.	1971	97	2376	99
20 min.	1925	95	2365	99
25 min.	ND	ND	2354	98
30 min.	1915	95	2341	98
35 min.	ND	ND	2347	98
40 min.	1867	92	2343	98
45 min.	ND	ND	2332	98
50 min.	1857	92	2322	97
55 min.	ND	ND	2329	97
60 min.	1848	91	2323	97
70 min.	1829	90	2287	96
80 min.	1812	90	2292	96
90 min.	ND	ND	2298	96
100 min.	1823	90	2296	96
110 min.	ND	ND	2277	95
120 min.	1853	92	2274	95
140 min.	ND	ND	2269	95
150 min.	1824	90	ND	ND
160 min.	ND	ND	2254	94
180 min.	1806	89	2235	93
210 min.	1789	88	2253	94
240 min.	1782	88	ND	ND
270 min.	1783	88	ND	ND
300 min.	1798	89	ND	ND
330 min.	1800	89	ND	ND
360 min.	1818	90	ND	ND
390 min.	1786	88	ND	ND
24 hours	ND	ND	2082	87
72 hours	1655	82	ND	ND
120 hours	ND	ND	1799	75
144 hours	ND	ND	1778	74

Panels grit blasted at 20 degrees with Zirclean media. Stand-off distance set to 1/4" for D6AC steel. cV=centivolts. Conditions: 75°F/45% RH. AC75a/2/96

Table 22 : OSEE III RESPONSES VERSUS TIME FOR GRIT BLASTED 7075-T73 ALUMINUM

Time After Grit Blast	Average Counts Trial 1	% Initial Signal Trial 1	Average Counts Trial 2	% Initial Signal Trial 2
0 min.	2005	100	2022	100
5 min.	1742	87	1997	99
10 min.	1547	77	1855	92
15 min.	1396	70	1684	83
20 min.	1274	64	1547	77
25 min.	1219	61	1521	75
30 min.	1175	59	1448	72
35 min.	1134	57	1355	67
40 min.	1072	53	1309	65
45 min.	1079	54	1260	62
50 min.	1038	52	1217	60
55 min.	1004	50	1189	59
60 min.	981	49	1153	57
70 min.	928	46	1066	53
80 min.	866	43	1031	51
90 min.	833	42	948	47
100 min.	823	41	914	45
110 min.	789	39	899	44
120 min.	782	39	868	43
140 min.	717	36	828	41
160 min.	698	35	773	38
180 min.	738	37	753	37
210 min.	673	34	717	35
240 min.	652	33	689	34
270 min.	620	31	655	32
300 min.	652	33	ND	ND
24 hours	449	22	521	26
48 hours	400	20	413	20
72 hours	ND	ND	364	18
144 hours	333	17	ND	ND
168 hours	309	15	372	18
192 hours	ND	ND	294	15

Scan parameters: 1/4" stand-off, scan speed 4, continuous scanning mode, 6" sensor #2. Grit blast angle 20 degrees. Conditions: 75°F/45% RH. AC75c/2/96

Table 23 : COMPARISON OF OSEE II AND OSEE III RESPONSES TO GRIT BLASTED 7075-T73 ALUMINUM

Trial #	*Min. After Blast*	*Avg. Counts OSEE III*	*Avg. Centivolts OSEE II*	*% Init. Counts OSEE III*	*% Init. cV OSEE II*
1	2	1992	ND	100	ND
	4	ND	2175	ND	100
	8	1818	ND	91	ND
	11	ND	2068	ND	95
	14	1551	ND	78	ND
	16	ND	2024	ND	93
	23	1268	ND	64	ND
	26	ND	1936	ND	89
	29	1190	ND	60	ND
	33	ND	1912	ND	88
	37	1107	ND	56	ND
	39	ND	1881	ND	86
	43	1062	ND	53	ND
	45	ND	1846	ND	85
	49	1016	ND	51	ND
	51	ND	1826	ND	84
	55	988	ND	50	ND
	57	ND	1810	ND	83
	61	966	ND	48	ND
	63	ND	1811	ND	83
	67	929	ND	47	ND
	69	ND	1795	ND	83
	74	894	ND	45	ND
	77	ND	1780	ND	82
	82	883	ND	44	ND
	85	ND	1776	ND	82
	93	836	ND	42	ND
	97	ND	1760	ND	81
	104	819	ND	41	ND
	107	ND	1754	ND	81
	115	784	ND	39	ND
	118	ND	1747	ND	80
	125	778	ND	39	ND
	129	ND	1733	ND	80
	135	760	ND	38	ND
	138	ND	1728	ND	79
	146	756	ND	38	ND
	151	ND	1712	ND	79
	158	737	ND	37	ND
	162	ND	1709	ND	79
	168	714	ND	36	ND

Single aluminum panel scanned with both instruments. Stand-off distance 1/4" for OSEE III, and set to 1/4" from D6AC steel for OSEE II. OSEE III configuration: sensor #2, continuous scanning mode, scan speed 4. Conditions: 75°F/45% RH. AC75f/2/96

Table 23 : COMPARISON OF OSEE II AND OSEE III RESPONSES TO GRIT BLASTED 7075-T73 ALUMINUM

	172	ND	1718	ND	79
	177	702	ND	35	ND
	180	ND	1696	ND	78
	186	712	ND	36	ND
	189	ND	1703	ND	78
	199	685	ND	34	ND
	203	ND	1697	ND	78
	212	680	ND	34	ND
	215	ND	1689	ND	78
	222	665	ND	33	ND
	227	ND	1690	ND	78
2	2	1809	ND	100	ND
	5	ND	2129	ND	100
	9	1739	ND	96	ND
	13	ND	1986	ND	93
	17	1372	ND	76	ND
	20	ND	1904	ND	89
	24	1142	ND	63	ND
	27	ND	1843	ND	87
	31	1072	ND	59	ND
	34	ND	1804	ND	85
	38	991	ND	55	ND
	41	ND	1779	ND	84
	45	910	ND	50	ND
	48	ND	1742	ND	82
	52	874	ND	48	ND
	55	ND	1722	ND	81
	59	848	ND	47	ND
	62	ND	1702	ND	80
	65	736	ND	41	ND
	68	ND	1685	ND	79
	71	775	ND	43	ND
	74	ND	1648	ND	77
	78	762	ND	42	ND
	81	ND	1641	ND	77
	84	742	ND	41	ND
	87	ND	1645	ND	77
	91	703	ND	39	ND
	94	ND	1636	ND	77
	98	706	ND	39	ND
	100	ND	1626	ND	76
	104	687	ND	38	ND
	112	680	ND	38	ND

Single aluminum panel scanned with both instruments. Stand-off distance 1/4" for OSEE III, and set to 1/4" from D6AC steel for OSEE II. OSEE III configuration: sensor #2, continuous scanning mode, scan speed 4. Conditions: 75°F/45% RH. AC75f/2/96

Table 23: COMPARISON OF OSEE II AND OSEE III RESPONSES TO GRIT BLASTED 7075-T73 ALUMINUM

116	ND	1595	ND	75
119	665	ND	37	ND
122	ND	1588	ND	75
125	651	ND	36	ND
128	ND	1589	ND	75
132	641	ND	35	ND
135	ND	1584	ND	74
139	621	ND	34	ND
142	ND	1577	ND	74
145	602	ND	33	ND
149	ND	1567	ND	74
153	598	ND	33	ND
157	ND	1557	ND	73
161	596	ND	33	ND
168	ND	1562	ND	73
173	584	ND	32	ND
182	ND	1549	ND	73
188	566	ND	31	ND
195	ND	1563	ND	73
200	563	ND	31	ND
203	ND	1539	ND	72
209	545	ND	30	ND
213	ND	1533	ND	72

Single aluminum panel scanned with both instruments. Stand-off distance 1/4" for OSEE III, and set to 1/4" from D6AC steel for OSEE II. OSEE III configuration: sensor #2, continuous scanning mode, scan speed 4. Conditions: 75°F/45% RH. AC75f/2/96

Table 24 : COMPARISON OF OSEE III RESPONSES TO GRIT BLASTED 7075-T73 ALUMINUM-WITH AND WITHOUT ARGON PURGING OF THE SENSOR/SUBSTRATE GAP REGION

Min. After Blast	*Avg. OSEE III Counts With Argon Purge*	*Avg. OSEE III Counts Without Argon Purge*	*% Initial Counts With Argon Purge*	*% Initial Counts Without Argon Purge*
2	ND	316	ND	100
4	1992	ND	100	ND
11	1818	ND	91	ND
15	ND	305	ND	97
16	1551	ND	78	ND
26	1268	ND	64	ND
30	ND	294	ND	93
33	1190	ND	60	ND
39	1107	ND	56	ND
45	1062	290	53	92
51	1016	ND	51	ND
57	988	ND	50	ND
60	ND	286	ND	91
63	966	ND	48	ND
69	929	ND	47	ND
73	ND	279	ND	88
77	894	ND	45	ND
85	883	ND	44	ND
90	ND	274	ND	87
97	836	ND	42	ND
105	ND	273	ND	86
107	819	ND	41	ND
118	784	ND	39	ND
120	ND	270	ND	85
129	778	ND	39	ND
135	ND	269	ND	85
138	760	ND	38	ND
150	ND	261	ND	83
151	756	ND	38	ND
162	737	ND	37	ND
165	ND	254	ND	80
172	714	ND	36	ND
180	702	248	35	78
189	712	ND	36	ND
195	ND	246	ND	78
203	685	ND	34	ND
210	ND	243	ND	77
215	680	ND	34	ND
225	ND	240	ND	76
227	665	ND	33	ND

Stand-off distance 1/4". OSEE III configuration: sensor #2, continuous scanning mode, scan speed 4. Grit blast angle 20 degrees. Conditions: 75°F/45% RH. AC75i/2/96

Table 24 : COMPARISON OF OSEE III RESPONSES TO GRIT BLASTED 7075-T73 ALUMINUM-WITH AND WITHOUT ARGON PURGING OF THE SENSOR/SUBSTRATE GAP REGION

240	ND	243	ND	77
255	ND	238	ND	75
270	ND	238	ND	75
285	ND	235	ND	74
300	ND	238	ND	75
315	ND	234	ND	74

Stand-off distance 1/4". OSEE III configuration: sensor #2, continuous scanning mode, scan speed 4. Grit blast angle 20 degrees. Conditions: 75°F/45% RH. AC75i/2/96

Table 25 : OSEE III RESPONSES TO D6AC STEEL WHEN THE SENSOR/SUBSTRATE GAP REGION WAS NOT PURGED WITH ARGON GAS

Analysis Mode	*Min. After Blast*	*Counts Channel 1*	*Counts Channel 2*	*Counts Channel 3*	*Counts Channel 4*	*Counts Channel 5*	*Counts Channel 6*	*Avg. Counts*	*% Init. Signal*
Argon to Gap	2	222	221	228	225	231	222	225	100
	8	198	196	202	200	206	202	201	89
	15	191	188	195	192	200	196	194	86
	21	193	191	198	194	202	199	196	87
	28	198	194	200	198	205	199	199	88
	36	195	191	197	196	204	199	197	88
	43	201	196	204	199	208	206	202	90
	50	200	195	202	198	204	201	200	89
	57	198	195	204	202	210	206	202	89
	77	193	193	197	185	189	191	191	85
	114	186	189	197	190	188	193	191	85
No Argon to Gap	2	99	93	95	97	102	99	97	100
	8	86	85	87	89	92	88	88	91
	14	82	81	84	87	90	87	85	88
	20	82	81	84	87	91	88	86	89
	27	78	82	85	88	102	89	88	91
	35	82	78	82	84	88	88	83	86
	41	83	82	84	87	92	89	86	89
	48	84	83	86	88	92	89	87	90
	70	84	83	86	88	93	91	87	90
	87	81	83	86	88	93	90	87	90
	111	82	81	85	87	92	89	86	89
	138	84	84	86	90	95	91	88	91

Scan parameters: continuous scanning mode, 1/4" stand-off, scan speed 4, 6" sensor #2. Grit blast angle 20 degrees. One panel was scanned with argon purge on, and a second panel was scanned with the argon purge off. Temp.=75F, RH=15%. AC76r/3/96

Table 26 : COMPARISON OF OSEE II AND OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL

Analysis Technique	*Min. After Grit Blast*	*Average Response*	*% Initial Signal*
OSEE III, Argon Purge To Gap	2	225 Counts	100
	8	201 Counts	89
	15	194 Counts	86
	21	196 Counts	87
	28	199 Counts	88
	36	197 Counts	88
	43	202 Counts	90
	50	200 Counts	89
	57	202 Counts	90
	77	191 Counts	85
	114	191 Counts	85
OSEE III, No Argon Purge To Gap	2	97 Counts	100
	8	88 Counts	91
	14	85 Counts	88
	20	86 Counts	89
	27	88 Counts	91
	35	83 Counts	86
	41	86 Counts	89
	48	87 Counts	90
	70	87 Counts	90
	87	87 Counts	90
	111	86 Counts	89
	138	88 Counts	91
OSEE II, Panel Exposed To Argon	4	850 cV	100
	10	819 cV	96
	16	811 cV	95
	23	807 cV	95
	31	815 cV	96
	39	817 cV	96
	45	813 cV	96
	52	810 cV	95
	62	792 cV	93
	79	780 cV	92
	116	771 cV	91
OSEE II, Panel Not Exposed To Argon	4	780 cV	100
	11	748 cV	96
	17	751 cV	96
	24	746 cV	96

1/4" stand-off, grit blast angle 20 degrees. OSEE III: speed 4, sensor #2, continuous mode. D6AC panels were shuttled between the two instruments. Temp.=75F, RH=15%. AC76T/3/96

Table 26: COMPARISON OF OSEE II AND OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL

30	743 cV	95
38	732 cV	94
45	736 cV	94
51	731 cV	94
67	724 cV	93
92	716 cV	92
106	717 cV	92
141	699 cV	90

1/4" stand-off, grit blast angle 20 degrees. OSEE III: speed 4, sensor #2, continuous mode. D6AC panels were shuttled between the two instruments. Temp.=75F, RH=15%. AC76T/3/96

Table 27 : EFFECT OF ARGON PURGE RATE ON OSEE III ANALYSES OF D6AC STEEL

SLPM*	Min.	C1	C2	C3	C4	C5	C6	Avg.	Delta**	% Init. Sig.
0	0	153	118	115	129	127	117	126	38	100
	3	126	98	95	110	108	97	106	31	84
	8	109	87	88	95	87	100	94	22	75
	15	99	79	79	93	91	81	87	20	69
	28	94	80	81	95	90	83	87	14	69
	34	95	79	80	94	85	81	86	16	68
	49	94	82	82	95	88	83	87	12	69
	87	100	81	81	93	90	81	88	19	70
	130	88	74	75	87	87	74	81	14	64
	177	93	77	76	88	79	76	82	17	65
1	0	156	144	181	227	263	255	204	119	100
	3	125	117	138	179	228	229	169	12	83
	8	97	94	100	113	136	145	114	51	56
	14	109	91	112	153	199	193	143	108	70
	22	119	116	137	169	201	186	155	85	76
	36	95	89	105	137	175	173	129	86	63
	55	95	91	104	133	170	172	127	81	62
	84	110	106	126	150	171	167	138	65	68
	118	88	84	87	99	122	131	102	47	50
	151	90	84	89	104	128	135	105	51	51
	181	102	86	98	128	160	160	122	74	60
2	0	201	217	230	254	279	250	238	78	100
	1	200	209	218	234	253	226	223	53	94
	5	172	181	189	204	226	206	196	54	82
	15	126	132	152	181	207	188	164	81	69
	26	111	112	132	166	206	191	153	95	64
	46	125	125	134	153	187	176	150	62	63
	77	163	168	172	183	200	181	177	37	75
	117	156	160	166	175	191	172	170	35	72
	144	173	164	166	172	188	169	172	24	72
	168	143	152	162	173	188	169	164	45	69
4	0	166	171	169	168	178	147	167	31	100
	5	189	186	181	180	194	175	184	13	110
	10	182	176	172	172	185	167	176	13	105
	18	175	168	166	162	176	161	168	15	101
	29	172	166	161	160	175	160	166	15	99
	37	178	173	169	168	184	166	173	18	104
	80	174	169	166	165	183	166	171	18	102
	127	170	165	160	160	173	157	164	16	98

Table 27: EFFECT OF ARGON PURGE RATE ON OSEE III ANALYSES OF D6AC STEEL

	186	170	163	159	157	171	155	163	16	97
5.4***	0	247	247	240	242	254	224	243	30	100
	2	218	217	212	215	228	201	215	27	88
	5	195	192	187	188	201	178	190	23	78
	13	181	178	172	173	186	163	176	23	72
	22	155	150	148	149	164	147	152	17	63
	36	158	152	146	146	160	142	151	18	62
	45	152	145	141	142	159	143	147	18	60
	58	142	137	134	136	152	138	140	18	58
	80	155	149	145	146	162	146	151	16	62
	107	151	146	143	145	161	144	148	18	61
	132	151	146	144	146	161	145	149	17	61
	153	158	152	149	149	165	149	154	16	63
	197	145	139	134	134	147	132	139	12	57
7	0	216	218	219	227	234	210	221	24	100
	3	194	195	195	201	207	185	196	22	88
	10	177	177	176	182	189	171	179	18	81
	18	176	174	172	179	186	171	176	15	80
	27	167	165	162	169	179	166	168	17	76
	41	166	166	164	171	178	162	168	16	76
	70	161	160	158	164	170	156	162	14	73
	107	157	154	151	156	163	149	155	14	70
	146	155	151	146	149	154	139	149	16	68
	177	141	141	139	144	151	139	142	12	64
10	0	184	199	200	216	221	207	205	37	100
	2	166	182	183	196	204	183	186	38	91
	5	163	176	176	186	191	174	178	28	87
	11	164	176	174	187	193	172	178	29	87
	27	147	157	156	170	176	163	162	29	79
	45	149	159	158	168	175	160	162	19	79
	60	136	146	145	156	165	149	150	29	73
	92	132	143	142	154	161	145	146	29	71
	130	128	136	136	148	153	137	140	25	68
	175	132	138	134	144	148	134	138	16	67
15	0	162	163	167	169	183	161	167	22	100
	2	144	144	148	149	163	144	149	19	89
	6	129	128	136	141	157	139	138	28	83
	16	144	143	146	149	164	145	148	21	89
	34	144	140	141	143	158	142	145	18	87
	54	141	139	142	145	162	147	146	23	88

Table 27 : EFFECT OF ARGON PURGE RATE ON OSEE III ANALYSES OF D6AC STEEL

82	147	144	145	148	164	148	149	20	89
126	143	138	138	143	161	147	145	23	87

Data reported in signal counts.

*=Standard Liters Per Minute.

**=Difference between channels.

***=Typical results for sensor #8.

Grit blast angle 20 degrees, stand-off 1/4", speed 1cm/sec., continuous mode.

Typical environmental conditions were 74-76F and 20-30% RH.

All data obtained with sensor #8.

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Table 28 : EFFEC S OF SCAN MODE AND SCAN SPEED ON OSEE III ANALYSES OF D6AC STEEL

Mode, Step Size, Spe l	*Min.*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*Avg.*	*Delta**	*% Init. Sig.*
Discrete, 2 cm, 1 cm/se ond	0	219	252	243	266	263	240	247	47	100
	2	203	234	225	245	240	213	227	42	92
	8	173	199	194	207	203	185	194	34	78
	16	161	185	180	192	190	180	182	31	73
	25	161	181	177	192	190	175	179	31	73
	52	147	168	159	172	174	167	165	27	67
	72	149	175	167	182	180	166	170	33	69
	95	147	168	163	175	175	166	166	28	67
	120	144	166	162	174	173	165	164	30	66
	201	164	186	176	196	198	177	183	34	74
Discrete, 1 cm, 1 cm/se ond	0	224	238	231	257	256	231	239	32	100
	5	207	217	213	238	243	224	224	36	94
	10	194	209	107	231	233	215	215	39	90
	20	186	195	197	223	219	196	203	37	85
	30	169	177	177	201	201	184	185	32	77
	40	183	194	188	212	206	189	195	29	82
	50	167	171	168	184	180	165	173	19	72
	60	166	169	162	178	177	159	169	28	71
	80	175	180	180	203	201	179	187	26	78
	100	178	184	181	204	199	176	187	28	78
	120	174	180	181	203	201	183	187	29	78
	140	171	177	175	198	194	177	182	27	76
	160	170	176	169	190	190	170	177	21	74
	180	181	185	180	200	197	177	187	20	78
Discrete, 2 cm, 0.5 cm second	0	201	240	225	238	224	201	222	39	100
	5	175	206	198	209	201	181	195	34	88
	10	163	195	189	201	189	176	186	38	84
	20	173	198	191	205	194	176	190	32	86

Table 28': EFFECTS OF SCAN MODE AND SCAN SPEED ON OSEE III ANALYSES OF D6AC STEEL

	30	160	186	178	190	182	166	177	30	80
	40	156	183	174	186	179	164	174	30	78
	50	165	191	178	190	178	165	178	26	80
	60	161	191	182	194	186	168	180	33	81
	80	155	189	180	191	179	166	177	36	80
	100	156	186	178	189	184	162	176	33	80
	120	152	182	176	184	178	164	173	32	78
	140	146	176	170	180	169	153	166	34	75
	160	158	187	178	187	177	159	174	29	78
	180	156	182	168	183	174	154	169	27	76
Discrete, 2 cm, 2 cm/second	0	210	236	222	244	240	225	230	34	100
	5	200	224	211	235	231	214	219	35	95
	10	185	205	194	211	208	196	200	26	87
	20	180	196	185	207	202	187	193	27	84
	30	171	187	181	197	195	183	186	28	81
	40	174	196	183	206	201	187	191	32	83
	50	176	195	183	205	202	185	191	29	83
	60	162	177	167	184	181	171	174	22	76
	80	161	178	169	188	185	174	176	27	77
	100	174	187	177	192	188	179	183	18	80
	120	165	182	169	185	187	174	177	22	77
	140	173	188	172	192	188	180	182	19	79
	160	157	171	161	180	180	171	170	23	74
	180	167	183	171	190	185	174	178	23	77
Discrete, 1 cm, 0.5 cm/second	0	208	247	237	254	243	220	235	46	100
	5	187	225	217	235	221	205	215	48	91
	10	180	219	206	220	210	195	205	40	87
	20	175	209	203	216	207	195	201	41	86
	30	171	203	193	202	191	176	189	31	80
	40	172	205	196	208	201	185	194	36	83

Table 28I: EFFECTS OF SCAN MODE AND SCAN SPEED ON OSEE III ANALYSES OF D6AC STEEL

	50	169	199	187	195	189	174	185	30	79
	60	164	196	187	200	194	180	187	36	80
	80	165	195	185	198	188	174	184	33	78
	100	155	186	175	186	177	160	173	31	74
	120	155	184	175	186	178	162	173	31	74
	140	149	178	169	182	173	161	169	33	72
	160	152	180	170	181	175	160	170	29	72
	180	153	182	171	182	175	160	171	29	72
Discrete, 1 cm, 2 cm/second	0	219	258	247	264	251	224	244	45	100
	5	191	227	218	233	222	199	215	42	88
	10	191	230	221	236	225	199	217	45	89
	20	183	218	210	226	215	192	208	43	85
	30	187	219	209	221	207	188	205	34	84
	40	167	203	196	210	202	181	193	43	79
	50	160	192	185	198	189	171	182	38	75
	60	162	191	183	195	186	170	181	33	74
	80	149	180	176	187	174	159	171	38	70
	100	146	172	165	178	168	151	163	32	67
	120	142	171	165	175	158	141	158	33	65
	140	139	167	162	173	161	140	157	34	64
	160	146	172	161	175	164	146	161	29	66
	180	142	170	165	175	166	146	161	33	66
Continuous, 10 cm, 1 cm/second	0	195	209	200	221	215	193	205	28	100
Baseline	5	180	192	182	200	195	177	188	23	92
	10	174	185	178	198	194	176	184	24	90
	20	165	175	169	191	187	166	175	26	85
	30	174	182	174	197	190	171	181	26	88
	40	172	177	170	188	182	163	175	25	85
	50	171	174	167	187	181	162	174	25	85
	60	172	176	166	185	179	157	173	28	84

Table 28 : EFFECTS OF SCAN MODE AND SCAN SPEED ON OSEE III ANALYSES OF D6AC STEEL

80	165	171	163	183	175	152	168	31	82
100	154	158	151	168	161	144	156	24	76
120	154	160	154	173	168	148	160	25	78
140	154	156	151	168	161	143	155	25	76
160	153	156	149	166	157	140	153	26	75
180	155	158	151	169	163	144	157	25	77

Scan path length=10 cm.

Data reported in signal counts.

*=Difference between channels.

Grit blast angle 20 degrees, stand-off 1/4", argon flow rate to sensor/substrate gap=5.4 SLPM.

Typical environmental conditions were 74-76F and 36-40% RH.

All data obtained with sensor #2.

Dotted lines show where instrument was switched from SCAN to STANDBY mode between analyses.

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Table 29 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "OLD" RACK , SENSOR #2

Min.	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch Av.	Delta	% Signal
0	194	191	194	210	234	211	206	43	100
5	171	170	173	187	211	190	184	41	89
10	164	162	163	176	200	179	174	38	84
20	157	154	154	167	188	168	165	34	80
30	154	149	149	162	180	164	160	31	78
40	143	142	142	153	174	157	152	32	74
50	146	139	138	149	166	153	148	27	72
60	144	136	138	148	168	154	148	32	72
80	138	132	130	142	162	148	142	32	89
100	134	128	127	137	157	145	138	30	67
120	131	125	123	133	150	141	134	27	65
140	131	123	123	129	151	142	133	28	65
160	132	124	124	133	152	142	134	28	65
180	126	119	118	125	138	126	125	20	61
0	198	201	209	209	219	201	206	21	100
10	175	177	181	182	192	176	181	17	88
20	162	161	167	167	179	168	167	18	57
30	157	159	162	165	173	162	163	16	79
40	150	150	155	153	160	151	153	10	74
50	148	145	150	148	158	153	150	13	73
60	146	144	146	146	152	149	147	8	71
80	144	136	138	148	168	154	148	32	72
100	138	132	130	142	162	148	142	30	69
120	134	128	127	137	157	145	138	29	67
140	131	125	123	133	150	141	134	25	65
160	131	123	123	129	151	142	133	27	65
180	132	124	124	133	152	142	134	28	65
0	207	216	221	214	214	186	210	35	100
5	190	195	199	196	196	172	191	27	91
10	170	176	181	180	182	152	173	30	82
20	166	169	174	169	175	155	168	20	80
30	164	169	170	164	173	152	165	21	79
40	160	165	168	164	169	149	163	20	78
50	144	143	144	141	147	133	142	14	68
60	153	155	157	155	160	146	154	14	73
80	149	148	150	147	150	140	147	10	70
100	150	151	153	148	152	142	149	11	71
120	138	142	143	141	146	137	141	9	67
140	152	150	153	147	158	151	152	11	72
160	135	138	145	141	142	105	134	37	65
180	133	140	141	138	146	139	139	13	66

Continuous mode, ,20 degree grit-blast angle, with Zirclean blast media. First, second data set at 1 cm/sec scan speed, third set at 2 cm/sec. "Old" rack (NASA #1255351).

Table 30 : OSEE SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #2

Min.	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch Av.	Ch Delta	% Signal
0	181	191	197	194	191	192	191	16	100
5	161	165	170	168	166	166	166	9	87
10	158	159	161	158	155	156	158	6	83
20	146	145	147	144	144	144	145	3	76
30	145	144	144	141	140	141	142	5	74
40	135	132	133	129	128	132	132	7	69
50	125	125	127	125	125	129	126	4	66
60	132	129	131	128	128	129	130	4	68
80	124	122	124	122	121	121	122	3	64
100	135	133	136	132	132	136	134	4	70
0	193	206	214	209	192	134	191	80	100
5	165	173	174	167	150	103	155	71	81
10	144	150	152	146	134	96	137	56	72
20	143	148	150	145	133	95	136	55	71
30	128	129	130	125	116	84	119	46	62
40	138	143	142	135	125	92	129	51	68
50	138	143	144	138	129	95	131	49	69
60	137	143	143	137	128	98	131	45	69
80	130	130	131	131	126	96	124	35	65
100	132	135	136	133	131	106	129	30	68
120	136	140	139	135	130	108	131	32	69
140	126	128	127	124	120	101	121	27	63
160	131	132	131	127	123	106	125	26	65
180	140	139	136	130	124	108	130	32	68
0	202	211	217	209	203	200	207	17	100
5	183	189	191	181	175	169	181	22	87
10	174	180	185	175	168	161	174	24	84
20	167	168	165	153	143	134	155	24	75
30	139	138	139	134	129	117	133	22	64
40	146	145	143	139	132	122	138	24	67
50	147	144	148	138	131	125	139	23	67
60	147	145	147	137	135	127	140	20	68
80	142	140	138	132	123	119	132	23	64
100	134	138	137	134	130	124	133	24	64
120	120	115	119	114	115	112	116	8	56
140	144	142	144	137	131	130	138	14	67
160	140	140	139	134	126	124	134	16	65
180	127	120	118	111	109	111	116	16	56

Continuous mode, 20 degree grit-blast angle, with Zirclean blast media. First, second data set at 1 cm/sec, third at 2 cm/sec, fourth at 0.5 cm/sec.

Table 31 : OSEE SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #2

Min.	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch Av	Ch Delta	% Signal
0	222	212	209	209	210	179	207	43	100
5	204	190	186	187	187	160	186	44	90
10	191	178	176	174	175	154	175	37	85
20	178	167	163	160	161	139	161	39	78
30	171	157	153	155	161	143	157	28	76
40	162	150	145	146	152	134	148	28	71
50	171	158	154	156	157	141	156	30	75
60	166	152	146	142	141	122	145	44	70
80	160	145	142	137	141	129	142	31	69
100	160	151	148	147	152	139	149	21	72
120	160	146	140	141	145	132	144	28	70
140	156	146	144	144	151	137	146	19	71
160	161	147	144	143	152	142	148	13	71

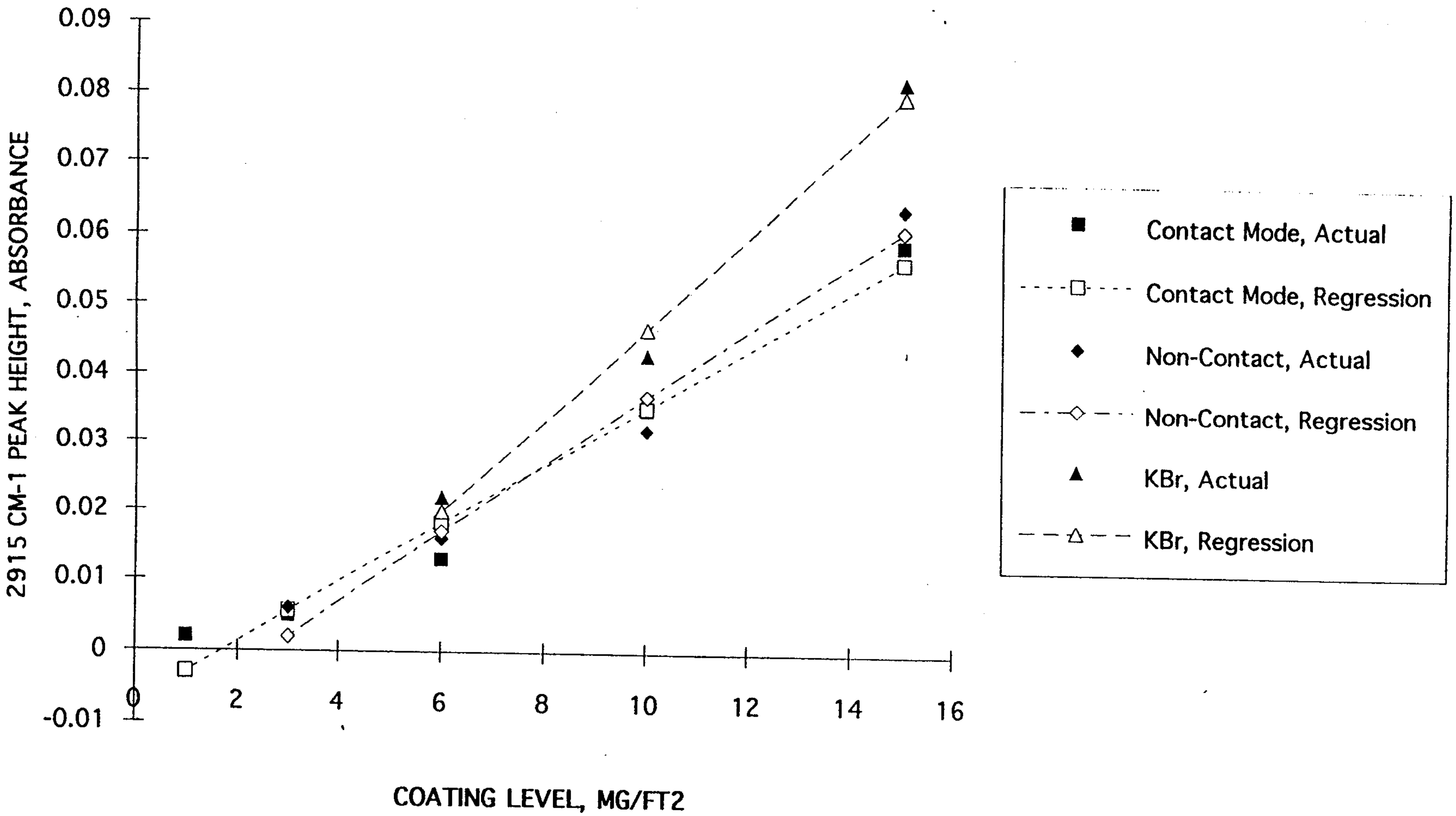
Continuous mode, 20 degree grit-blast angle, with Zirclean blast media. First second data set at 1 cm/sec, third at 2 cm/sec, fourth at 0.5 cm/sec.

Table 31 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL "NEW" RACK SENSOR #8

Min	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	CH AV	Ch Delta	% Signal
0	240	235	243	242	237	241	240	7	100
5	213	217	223	220	216	221	218	10	90
10	203	205	206	200	196	201	202	10	84
20	182	184	188	186	185	194	187	12	78
30	191	186	187	185	180	184	186	11	78
40	178	174	169	166	164	168	170	14	71
60	171	168	167	167	166	172	169	6	70
0	235	227	231	240	252	257	240	25	100
5	219	209	211	208	211	212	212	10	88
10	210	205	209	204	203	205	206	7	86
20	176	171	173	164	168	173	171	12	71
30	181	180	185	179	187	194	184	15	77
40	177	175	181	177	188	198	183	23	76
50	156	153	157	152	159	168	158	16	66
60	170	160	162	159	164	170	164	11	68
100	164	159	161	159	168	178	165	18	69
120	172	167	168	167	178	187	173	20	72
140	154	149	152	151	162	170	156	21	65
160	154	146	148	144	152	159	151	15	63
180	154	147	149	144	153	163	152	19	63
0	223	221	230	225	234	240	229	19	100
5	217	217	224	222	223	225	221	8	97
10	214	211	217	212	209	209	212	5	93
20	190	180	179	171	169	167	176	23	77
30	185	183	190	186	188	190	187	7	83
40	154	148	152	145	148	150	150	9	66
50	169	164	168	161	161	163	165	8	72
60	170	164	172	166	169	175	169	11	74
80	158	152	158	153	155	158	156	6	68
100	172	158	161	156	159	163	162	11	71
120	159	152	157	151	155	156	155	8	68
140	151	145	147	142	149	151	147	9	64
160	146	139	142	137	146	149	143	12	62
180	148	139	142	138	142	145	142	10	62

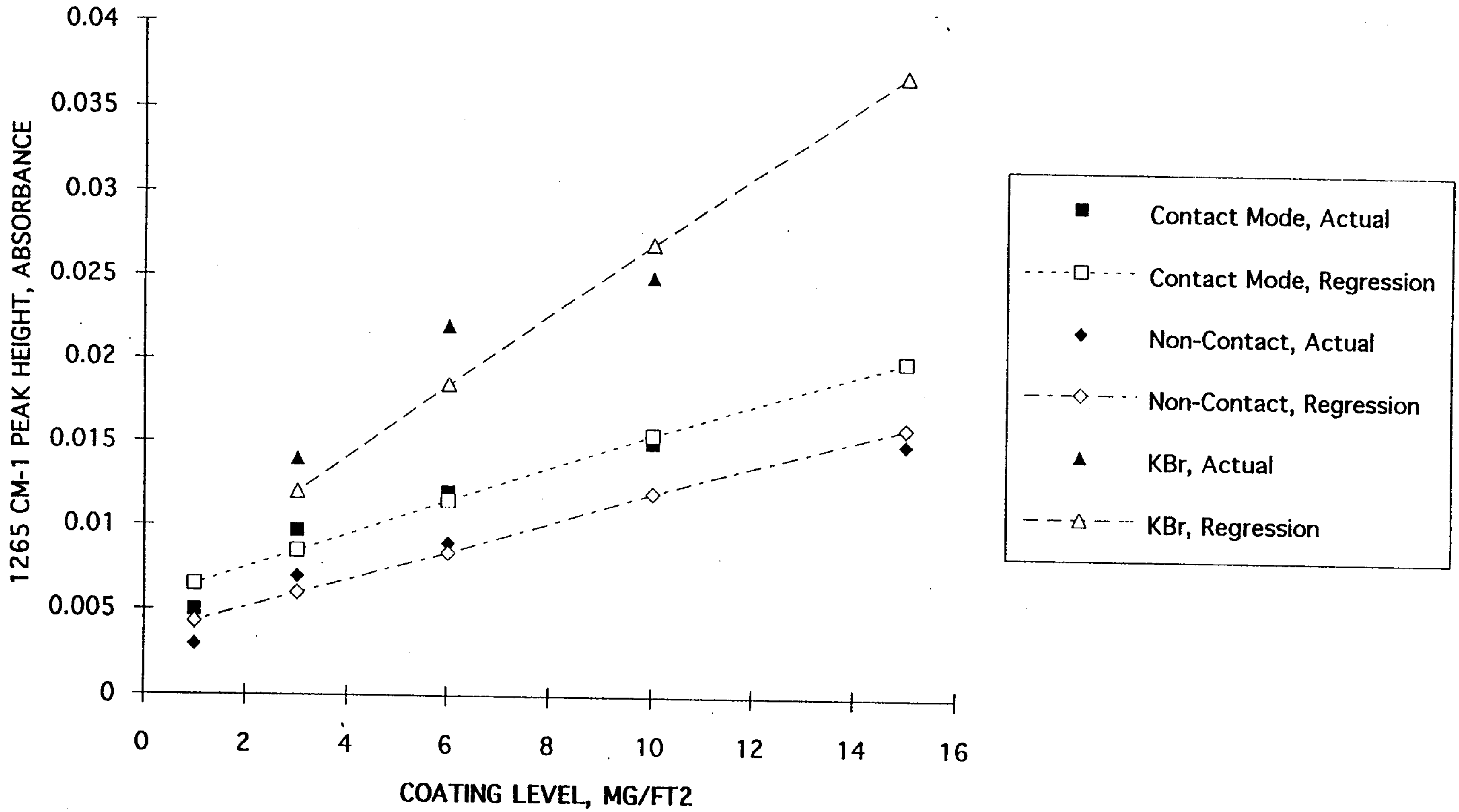
Continuous mode, 20 degree grit-blast angle, with Zirclean blast media. First second data set at 1 cm/sec, third set at 2 cm/sec scan speed. "New" rack (NASA #1255532)

Figure 1: COMPARISON OF D6AC/PARAFFIN ANALYSIS RESULTS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES



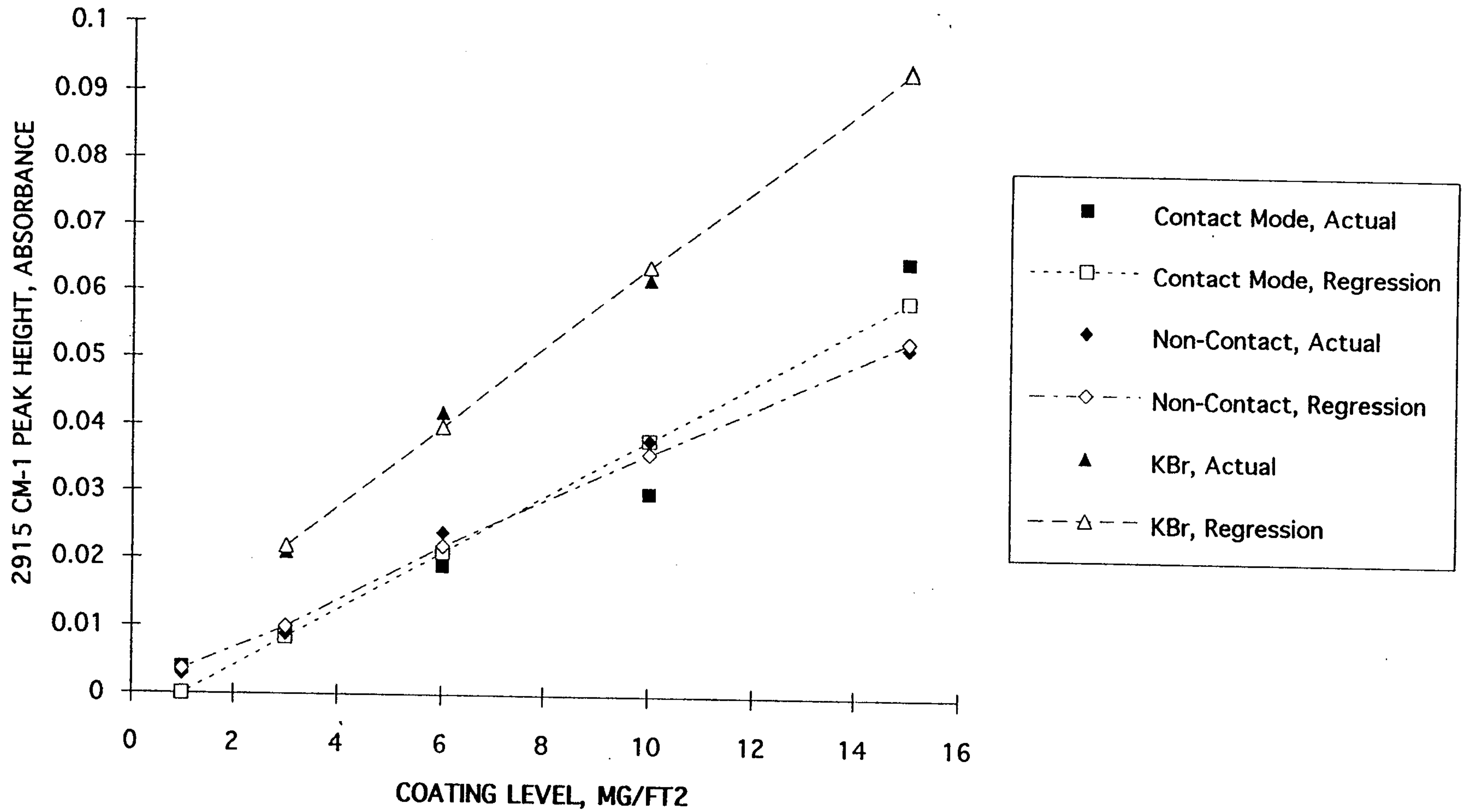
48 pulses per spectrum at a resolution setting of 16 cm-1. Non-contact stand-off distance was 50-60 mils. AC75t/2/96

Figure 2 : COMPARISON OF ALUMINUM/CRC SILICONE ANALYSIS RESULTS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES



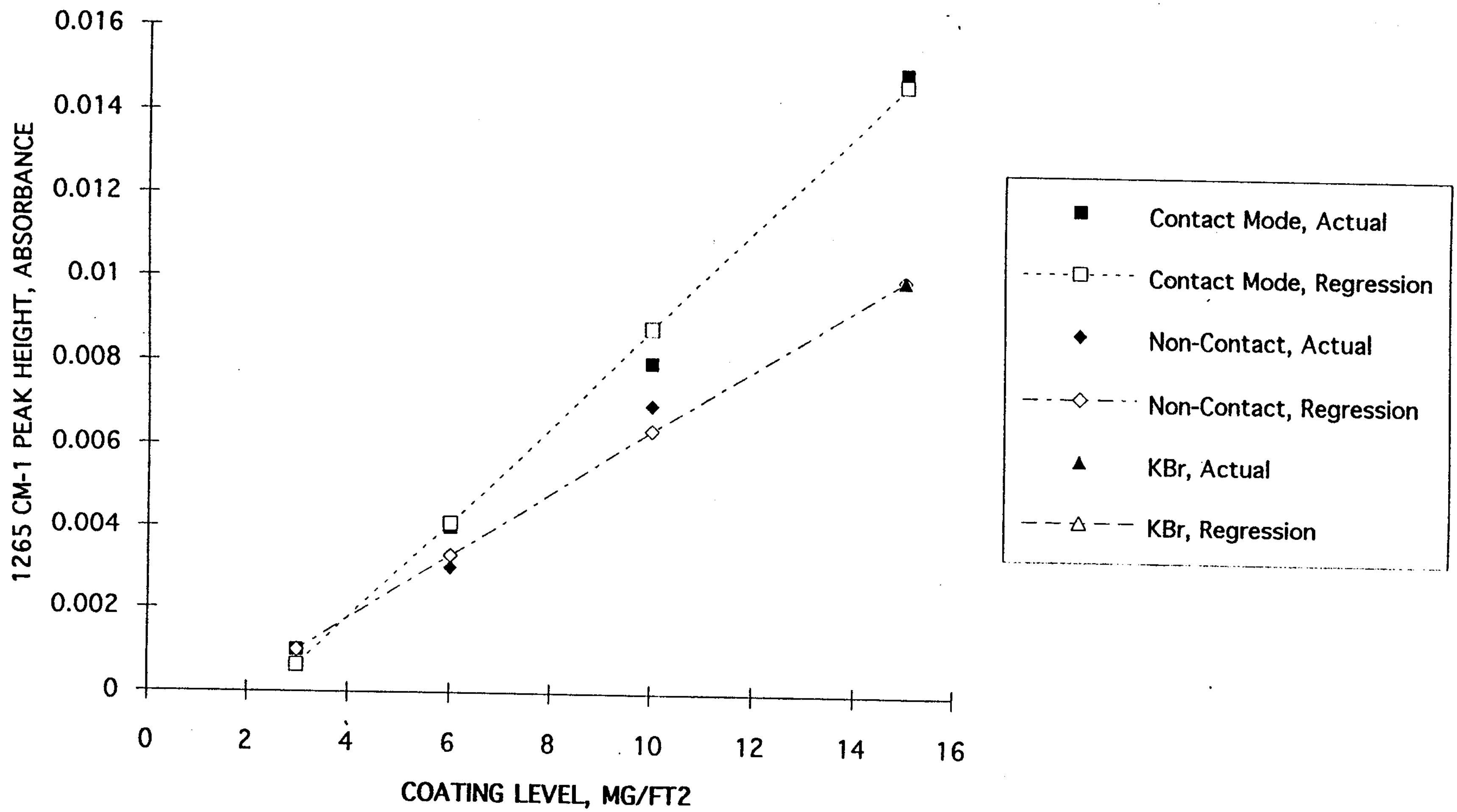
48 pulses per spectrum at a resolution setting of 16 cm-1. Non-contact stand-off distance was 50-60 mils. AC75U/2/96

Figure 3 : COMPARISON OF ALUMINUM/PARAFFIN ANALYSIS RESULTS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES



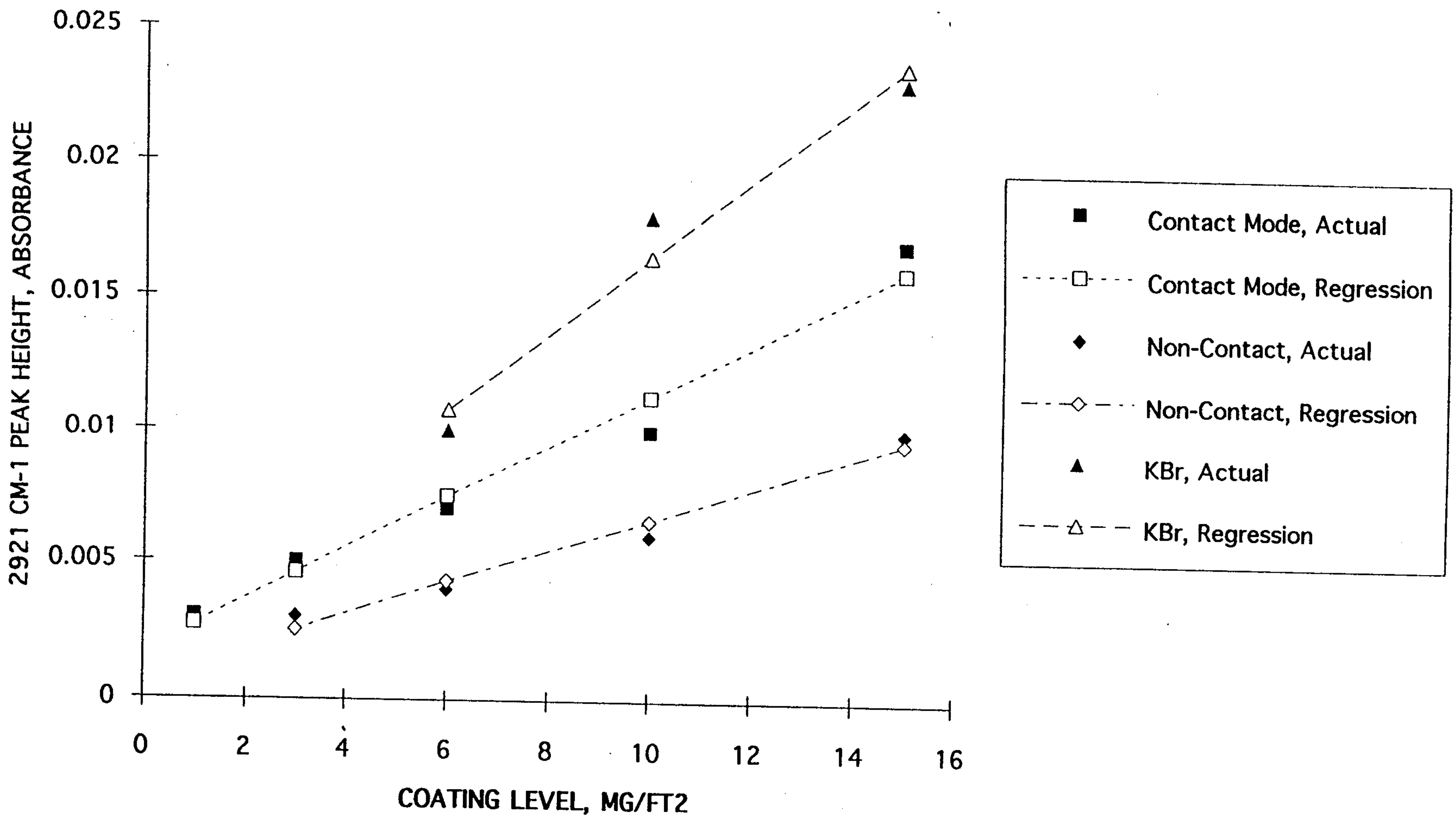
48 pulses per spectrum at a resolution setting of 16 cm-1. Non-contact stand-off distance was 50-60 mils. AC76i/3/96

Figure 4 : COMPARISON OF D6AC/CRC SILICONE ANALYSIS RESULTS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES



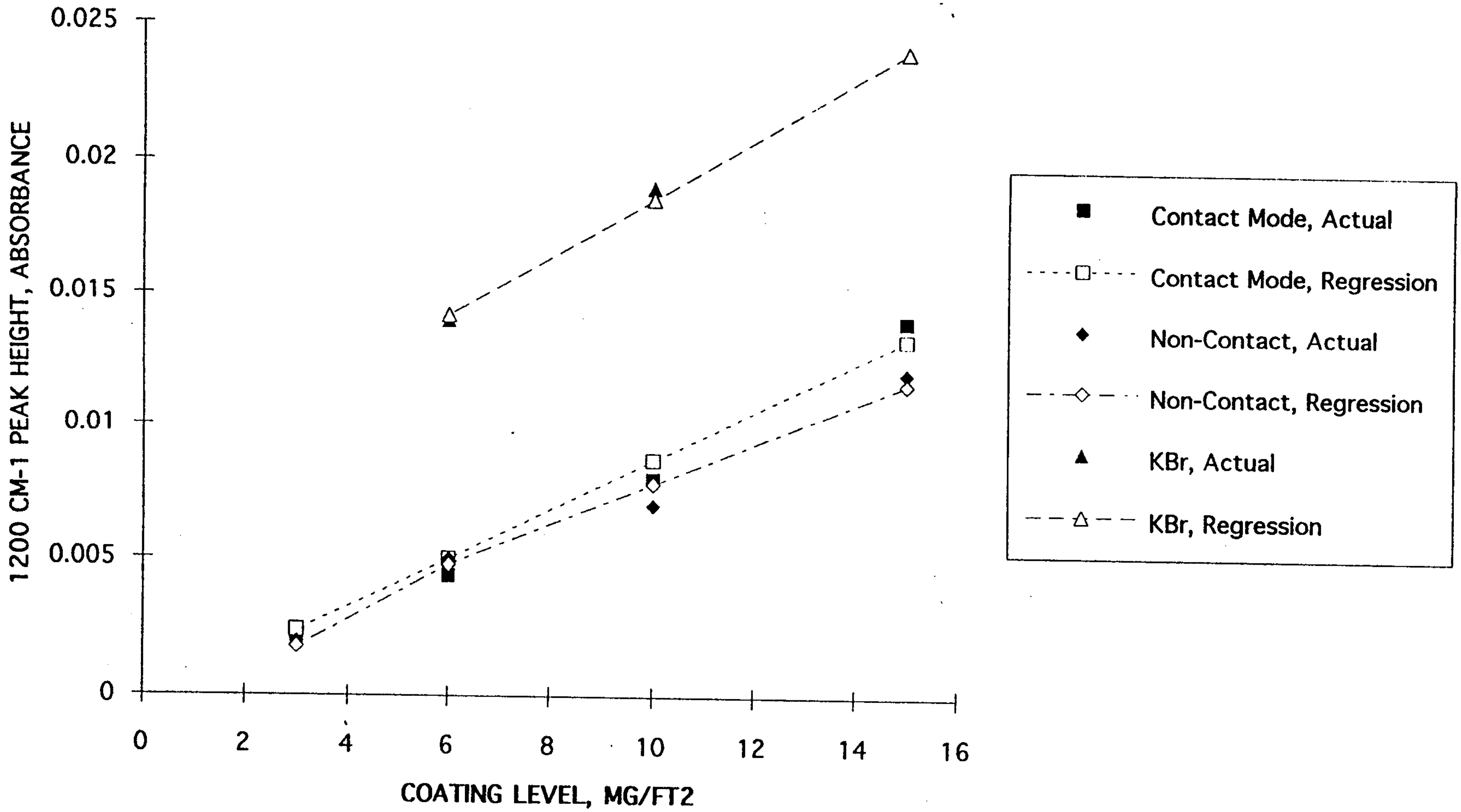
48 pulses per spectrum at a resolution setting of 16 cm-1. Non-contact stand-off distance was 50-60 mils. AC76j/3/96

Figure 5 : COMPARISON OF ALUMINUM/TRI-FLOW ANALYSIS RESULTS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES



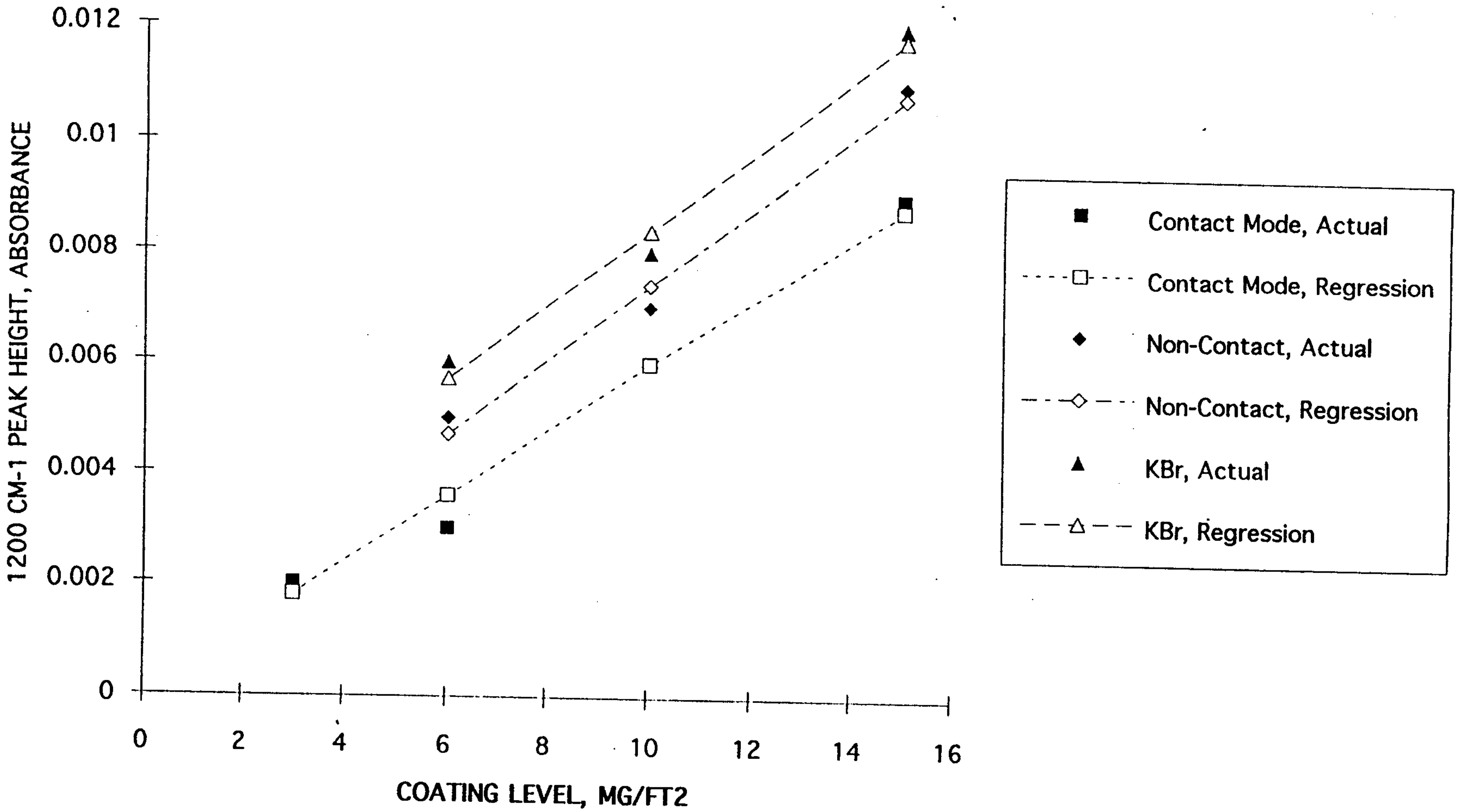
48 pulses per spectrum at a resolution setting of 16 cm-1. Non-contact stand-off distance was 50-60 mils. AC76k/3/96

Figure 6 : COMPARISON OF D6AC/FLUOROLUBE ANALYSIS RESULTS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES



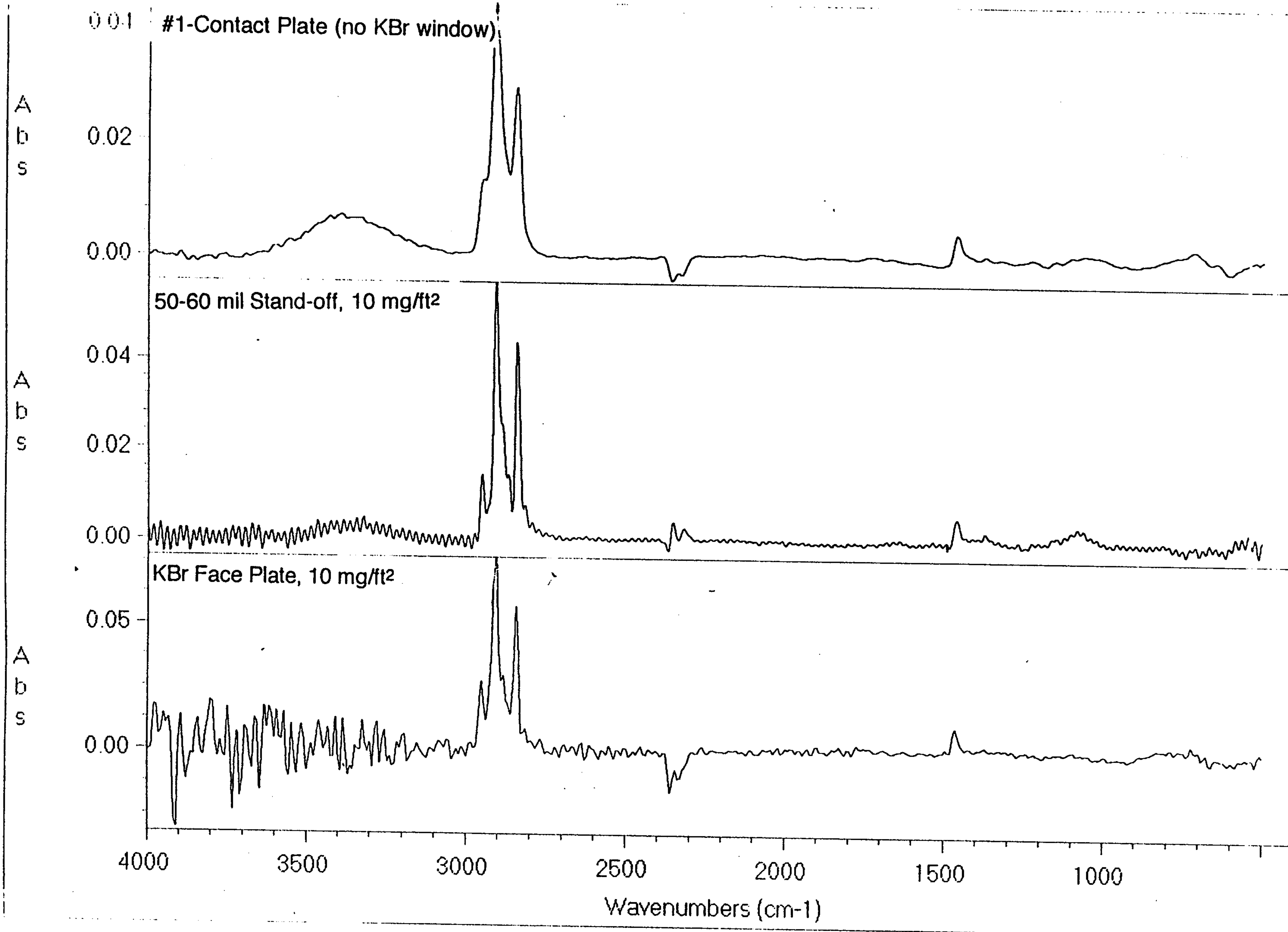
48 pulses per spectrum at a resolution setting of 16 cm-1. Non-contact stand-off distance was 50-60 mils. AC76L/3/96

Figure 7 : COMPARISON OF ALUMINUM/FLUOROLUBE ANALYSIS RESULTS WITH THE SIMIR CONTACT, NON-CONTACT AND KBR FACE PLATES



48 pulses per spectrum at a resolution setting of 16 cm-1. Non-contact stand-off distance was 50-60 mils. AC76M/3/96

Figure 8 : SIMIR SPECTRA OF PARAFFIN ON ALUMINUM USING THE CONTACT, NON-CONTACT AND KBR FACE PLATES



16 cm^{-1} resolution, 48 pulses per spectrum.

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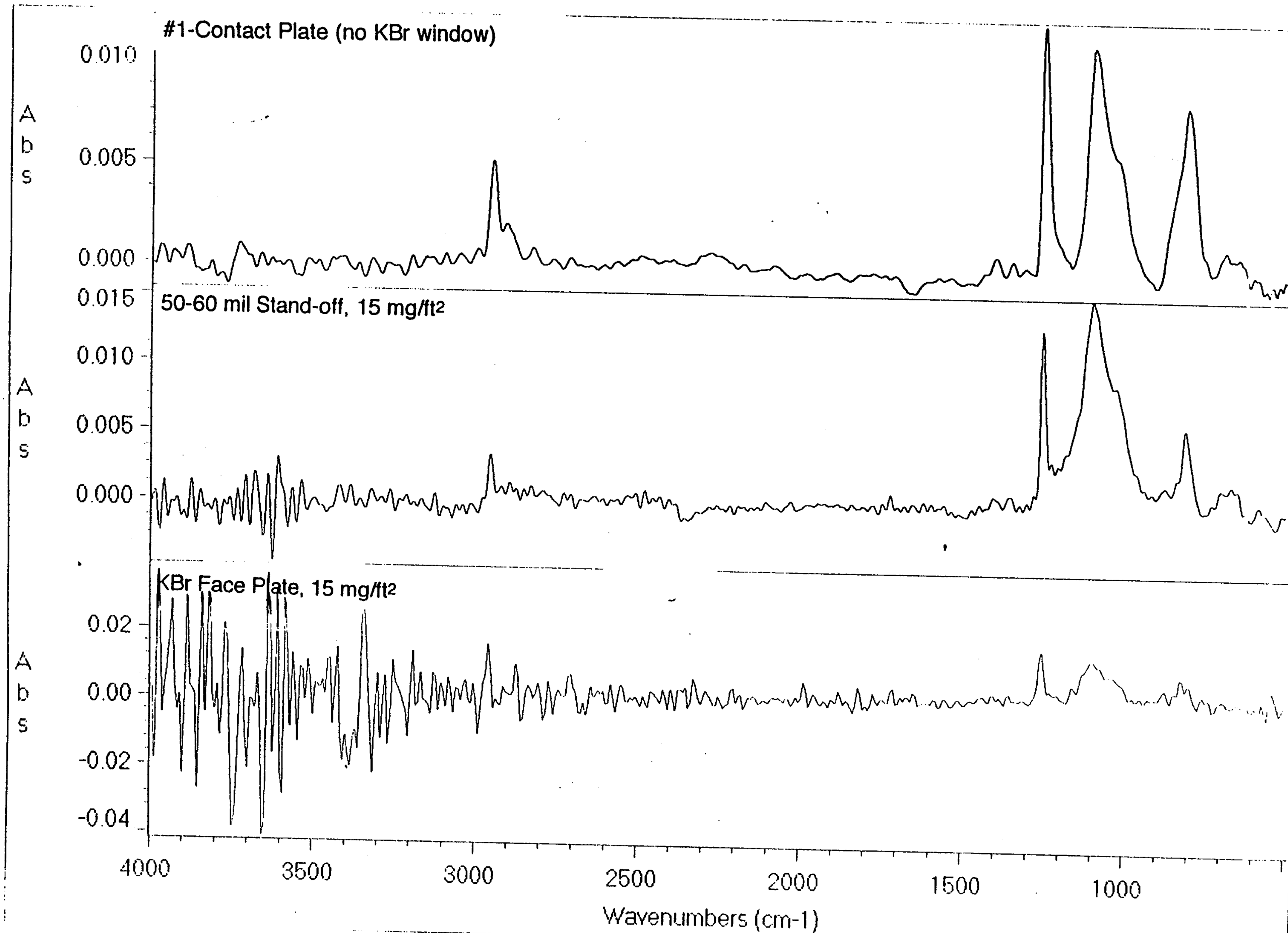
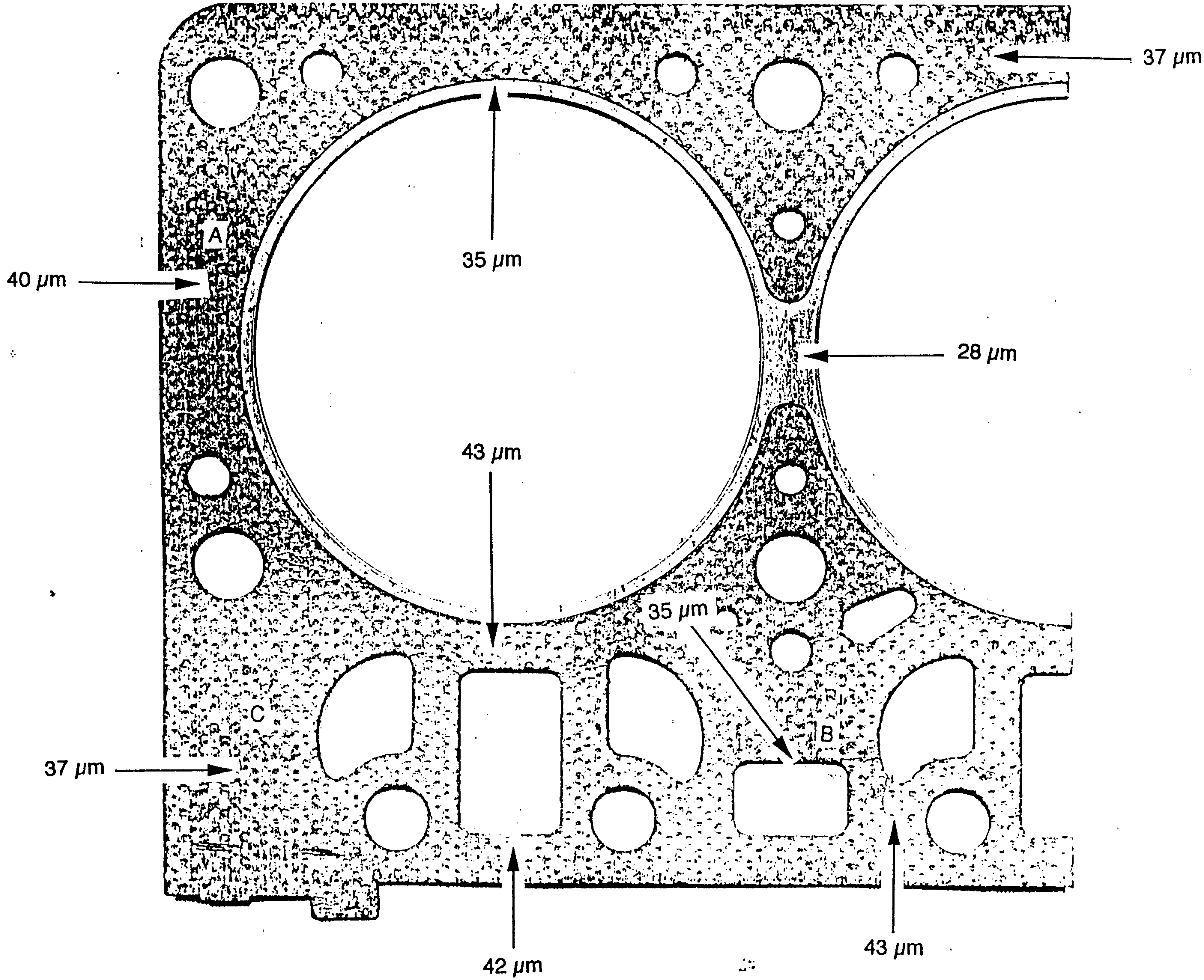
Figure 9 : SIMIR SPECTRA OF CRC SILICONE ON D6AC STEEL USING THE CONTACT, NON-CONTACT AND KBR FACE PLATES



16 cm^{-1} resolution, 48 pulses per spectrum.

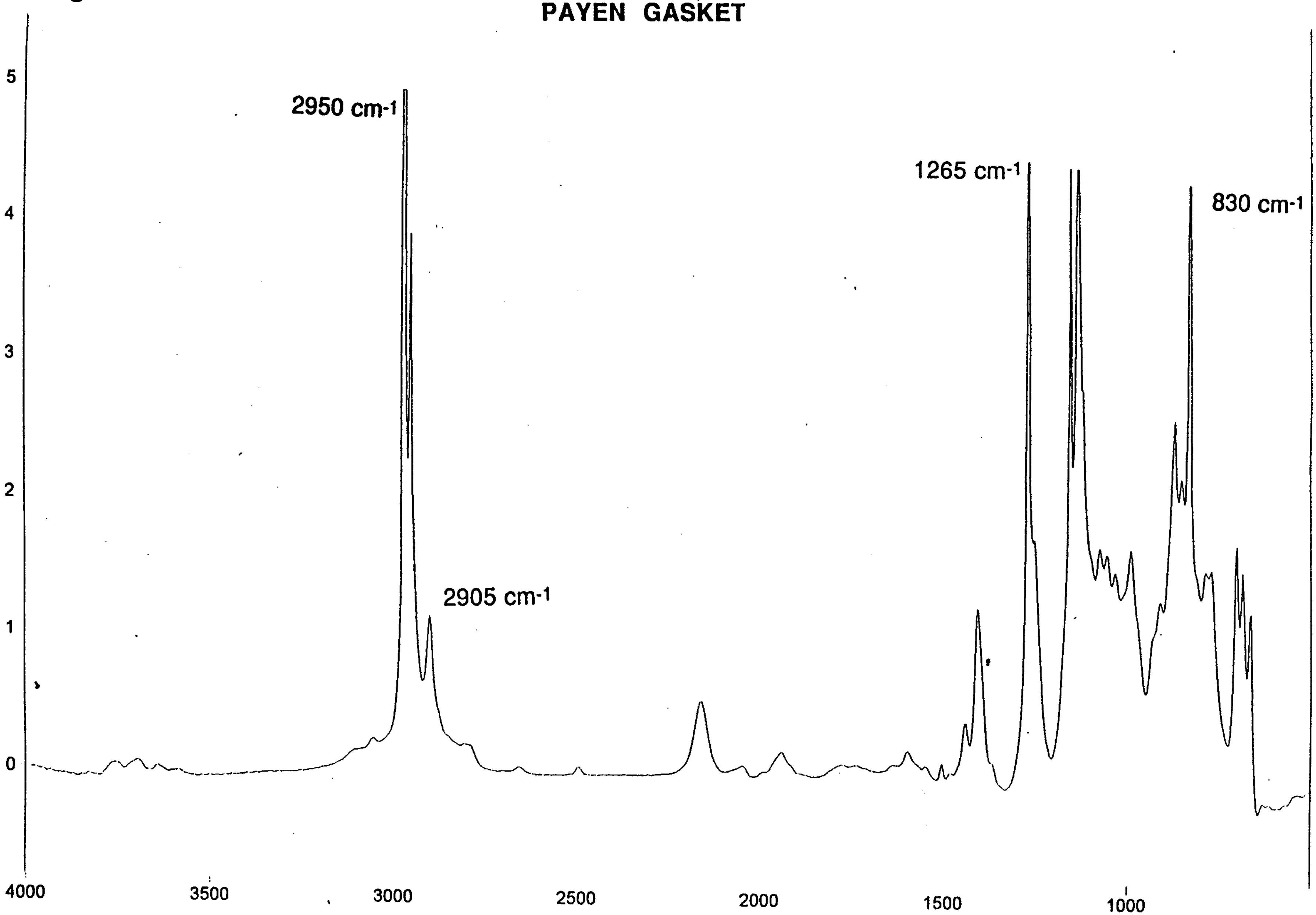
AC75w/2/96

Figure [illegible]: RESULTS FROM LIGHT SECTION MICROSCOPE ANALYSES OF RTV
SILICONE SPRAY APPLIED TO GASKET



Coating thi[illegible] 1.28

Figure 11: SIMIR SPECTRUM FROM 30 MICROMETER COATING OF RTV SILICONE ON McCORD-PAYEN GASKET



Absorbance / Wavenumber (cm-1)

File # 2 : GAS30B

Gasket with 30 micrometers silicone

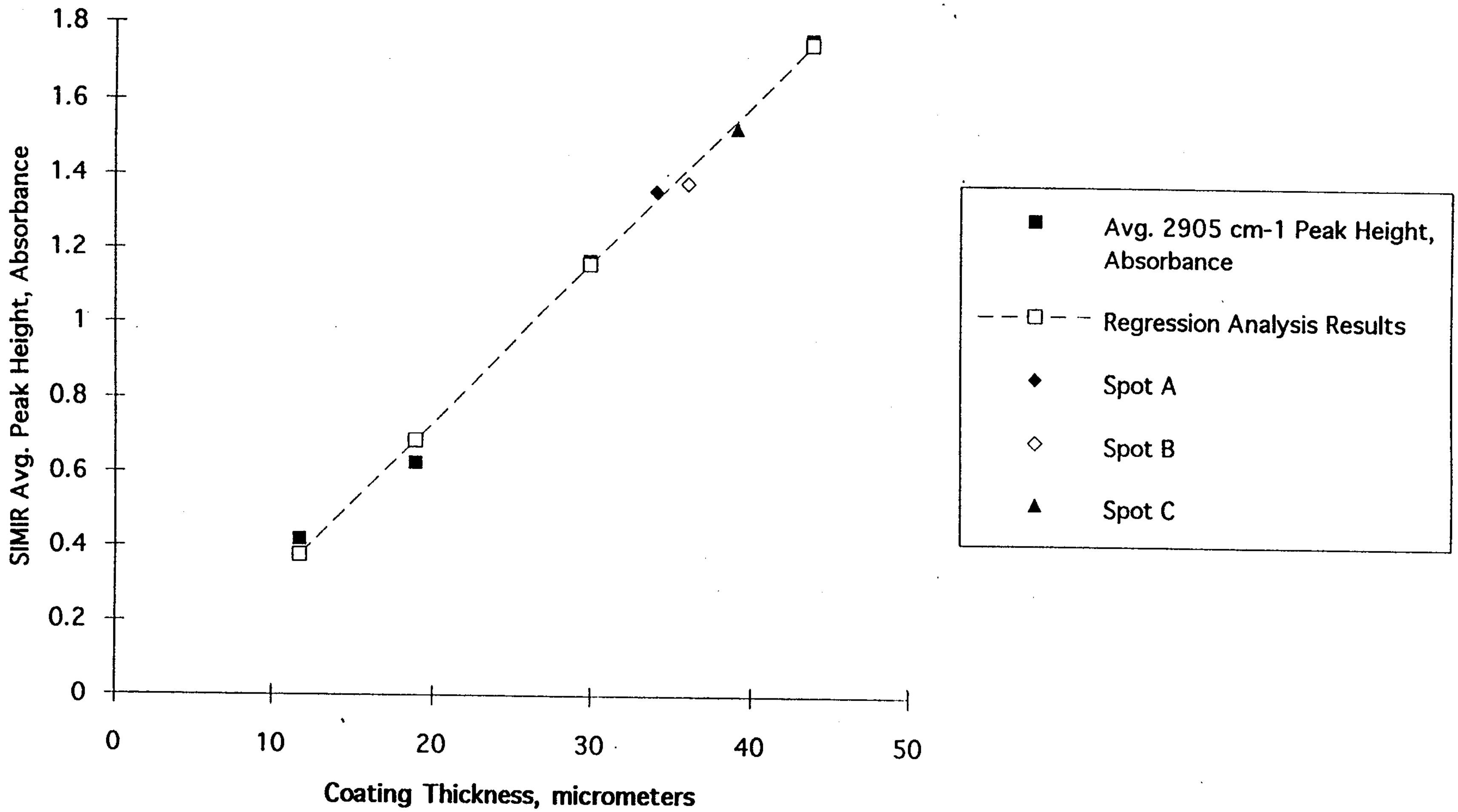
Scan Parameters: 4 pulses at 16 cm-1 resolution

Paged X-Zoom CURSOR

11/29/95 9:27 AM Res=16 cm-1

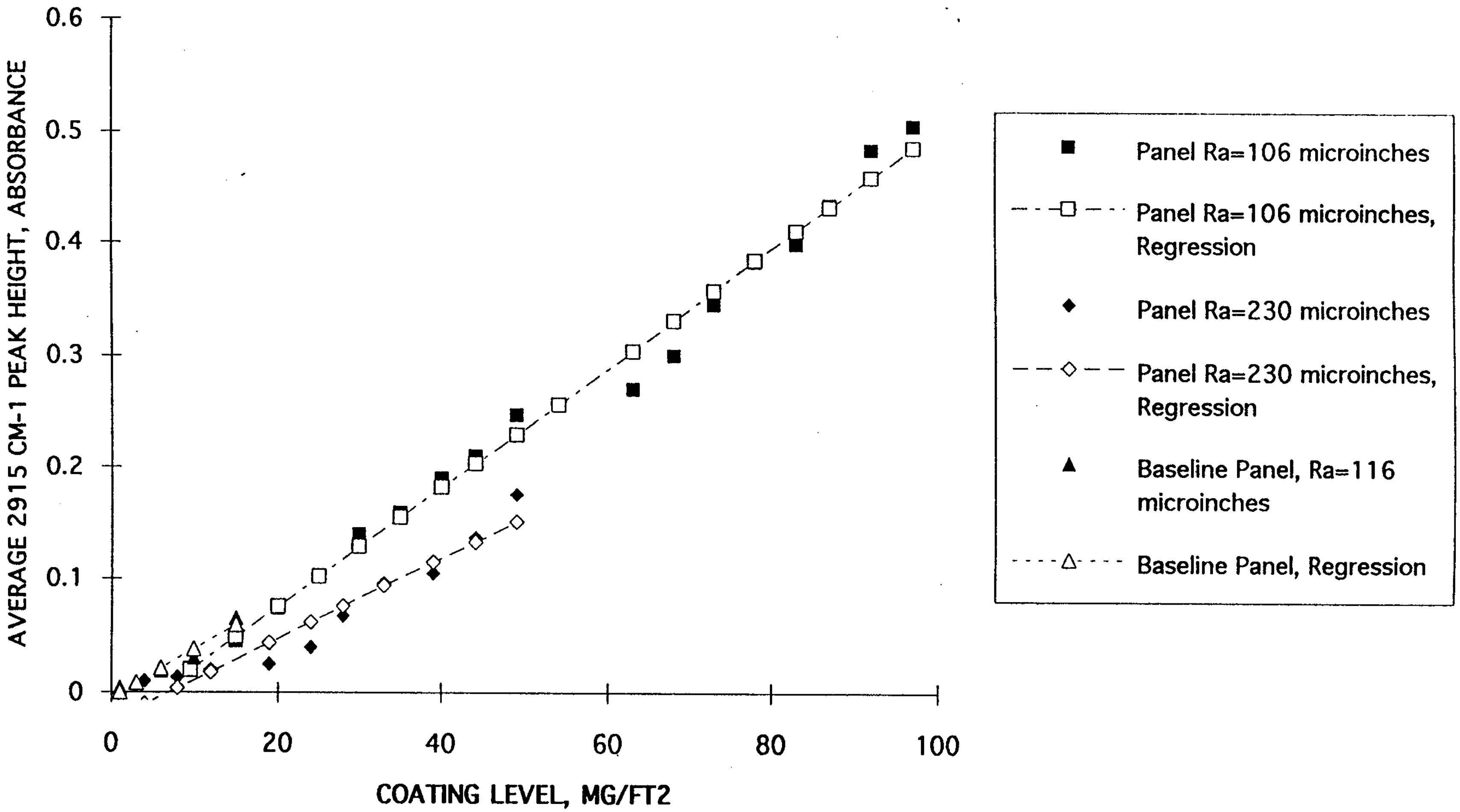
AC74i/1/96

Figure 12: SIMIR ANALYSIS RESULTS FROM GASKET/SILICONE CONTAMINATION STANDARD



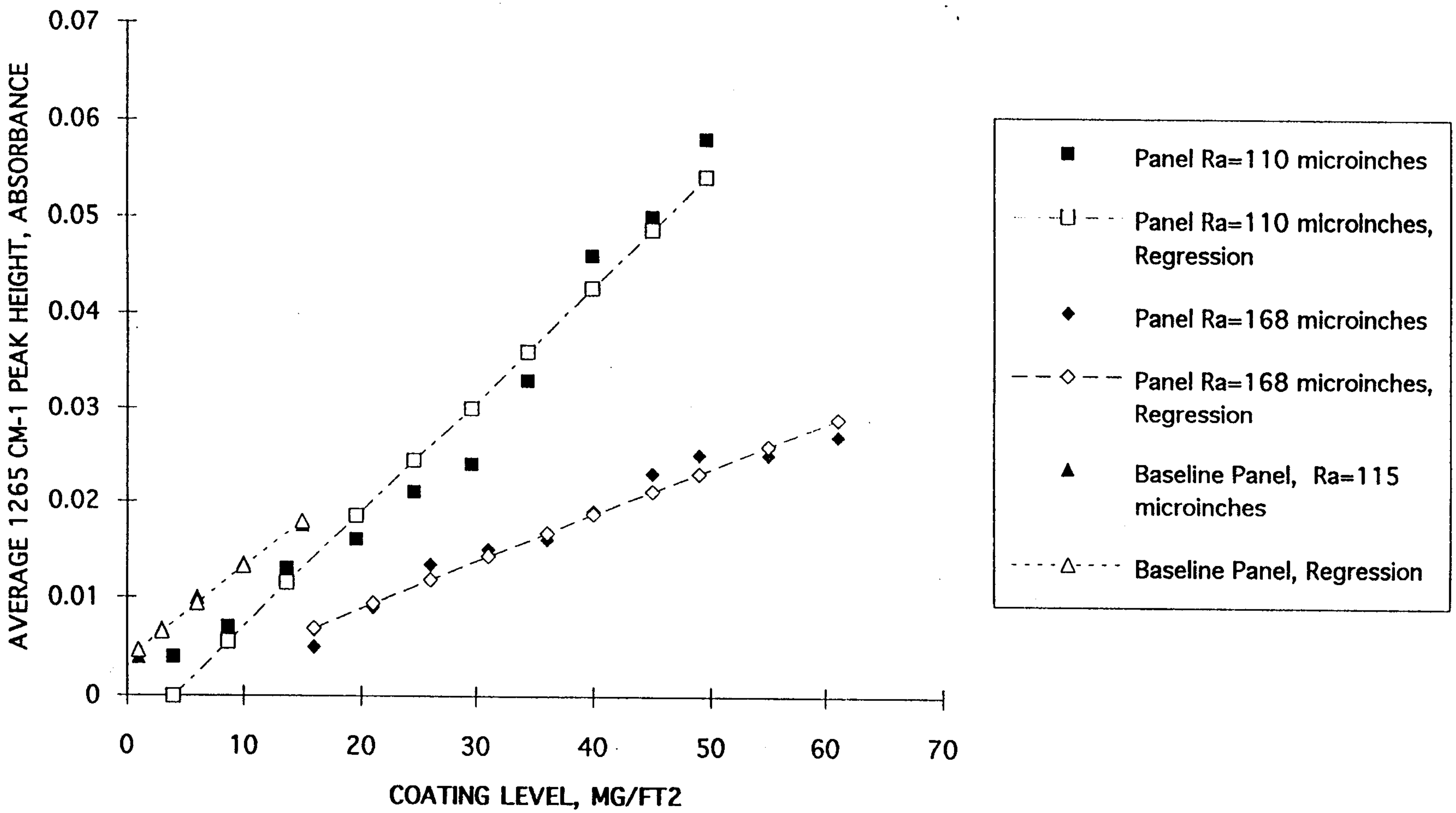
SIMIR parameters: 4 pulses, 16 cm-1 resolution, stand-off face plate @ 50-60 mils. Coating thicknesses based on light section microscope analyses assuming index of refraction=1.38. AC74o/1/96

Figure 13: RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/PARAFFIN CONTAMINATION STANDARDS



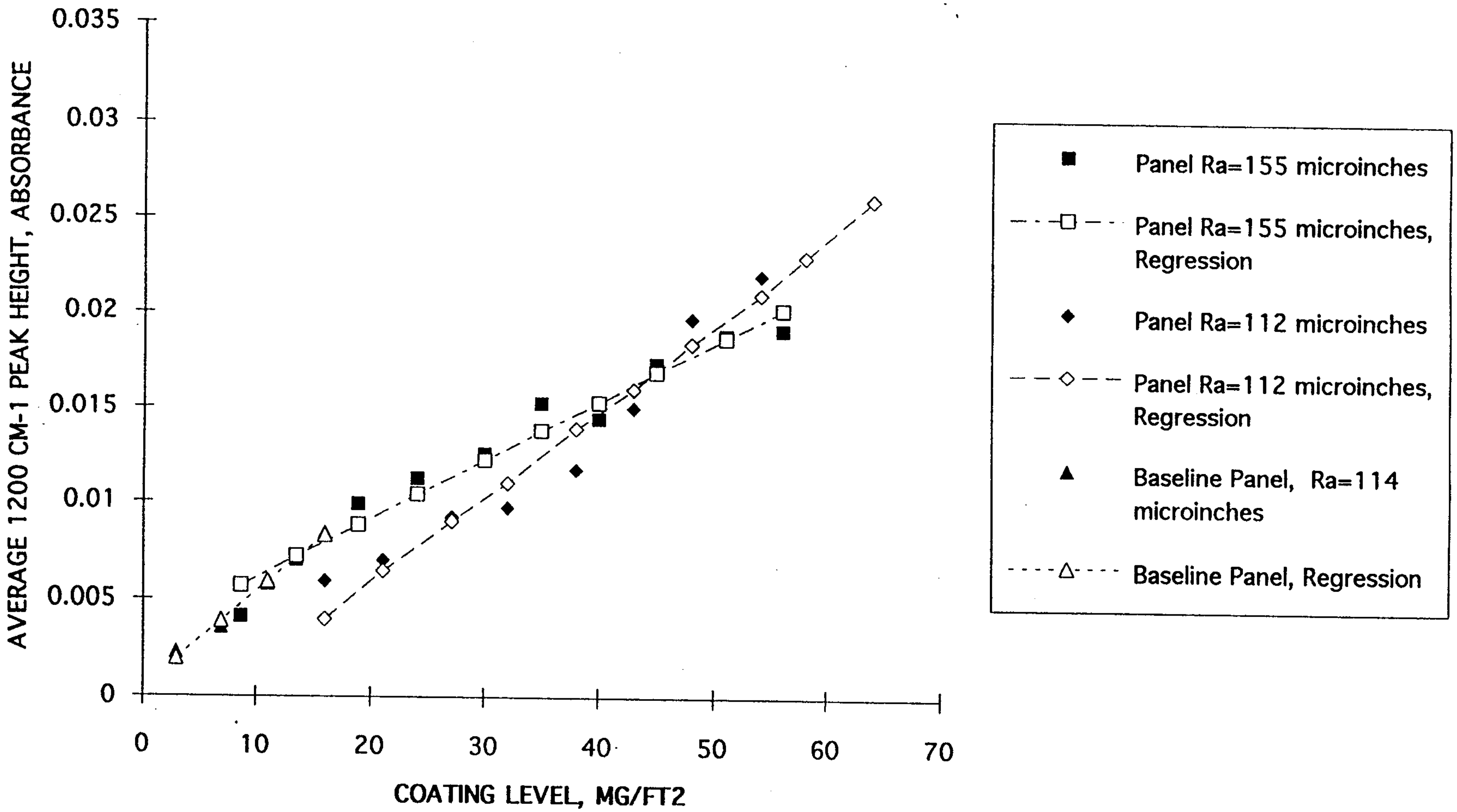
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. AC80b/6/96

Figure 14: RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS



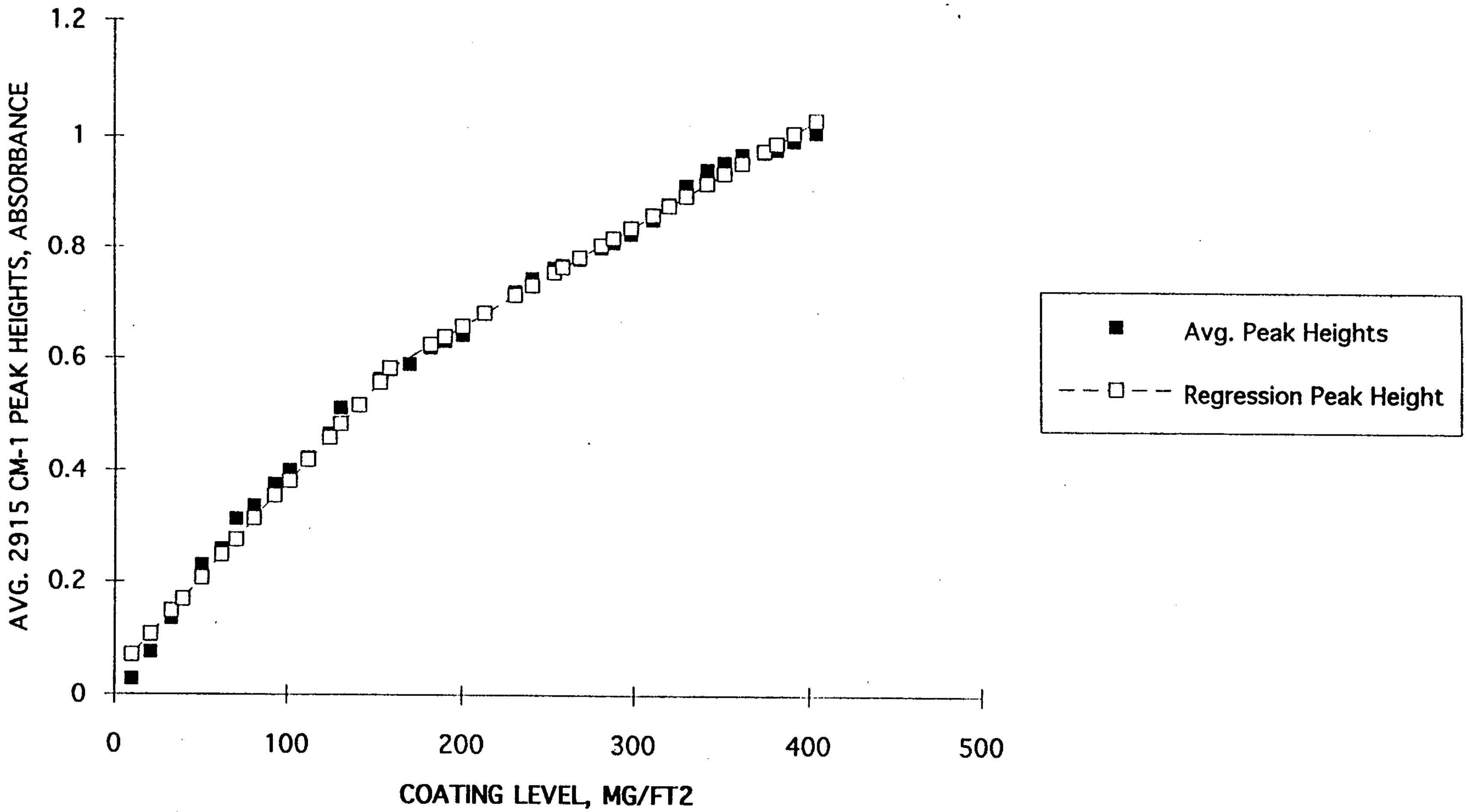
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. AC80c/6/96

Figure 15: RESULTS FROM SOC-400 CONTACT ANALYSES OF ALUMINUM/FLUOROLUBE CONTAMINATION STANDARDS



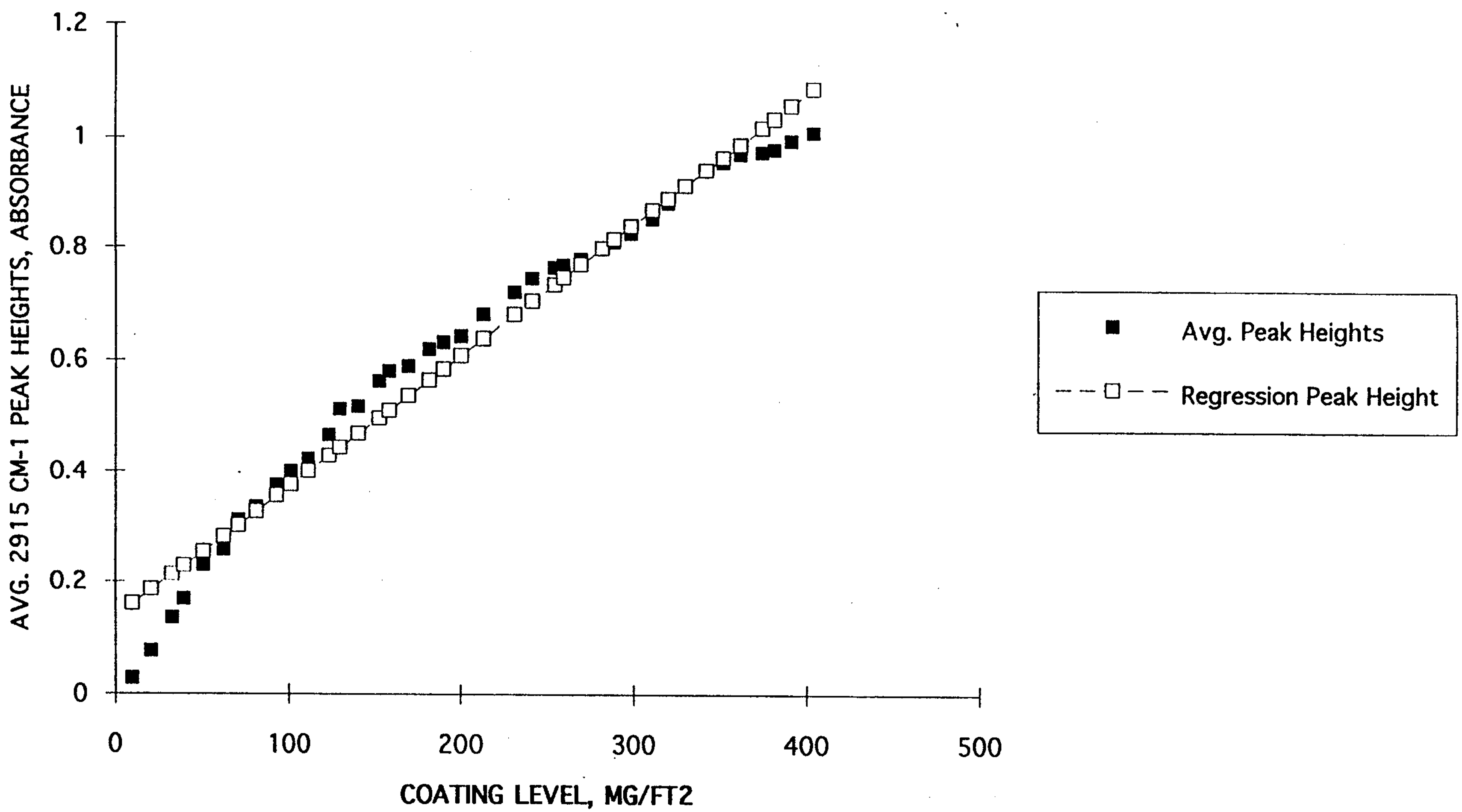
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. AC80e/6/96

Figure 16: SOC-400 NON-CONTACT ANALYSIS RESULTS FROM ALUMINUM/PARAFFIN CONTAMINATION STANDARDS



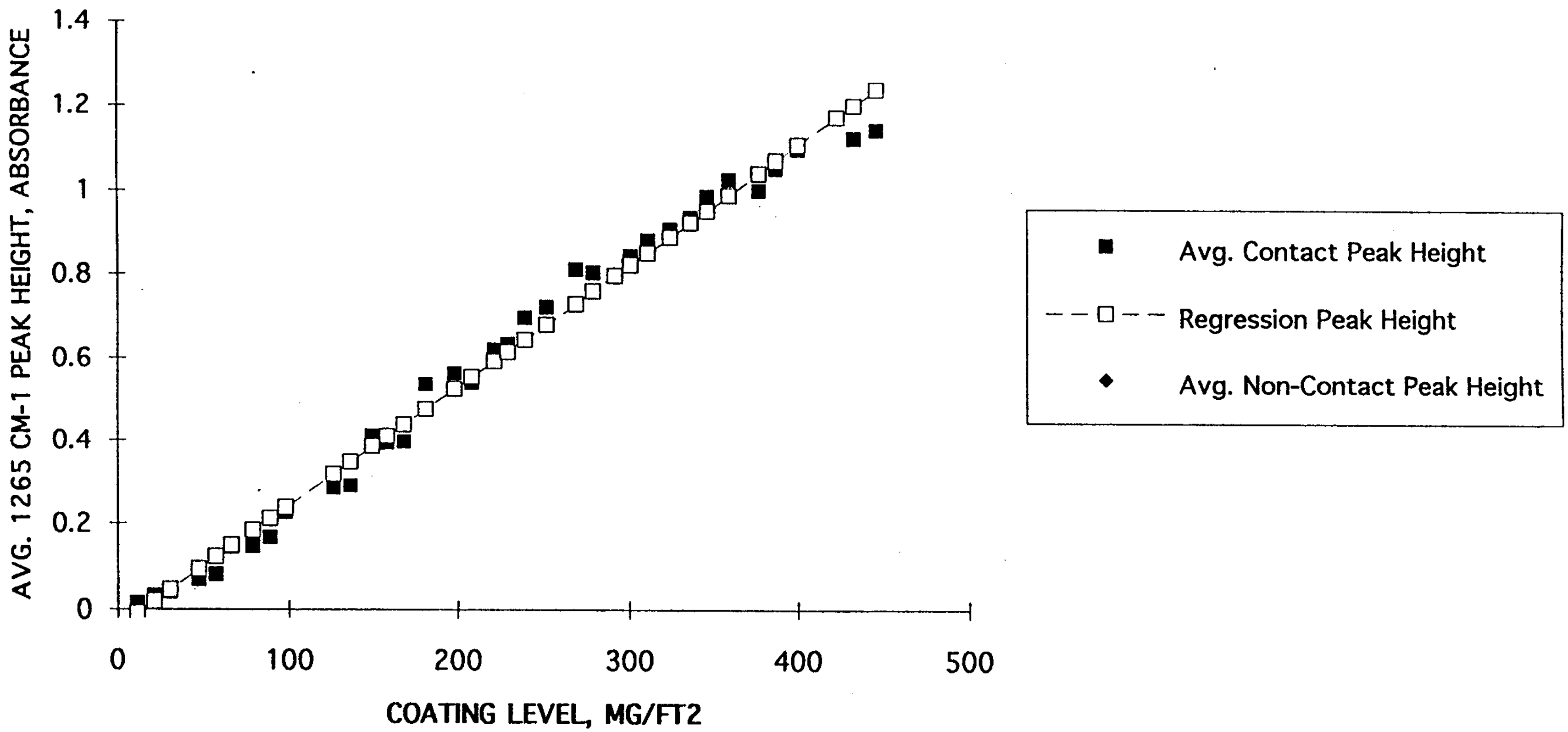
Scan parameters: 48 pulses per spectrum, 16 cm-1 resolution. Results were averages of five spectra per coating level. Correlation coefficients=0.98, 0.99. AC780n/6/96

Figure 17: SOC-400 NON-CONTACT ANALYSIS RESULTS FROM ALUMINUM/PARAFFIN CONTAMINATION STANDARDS



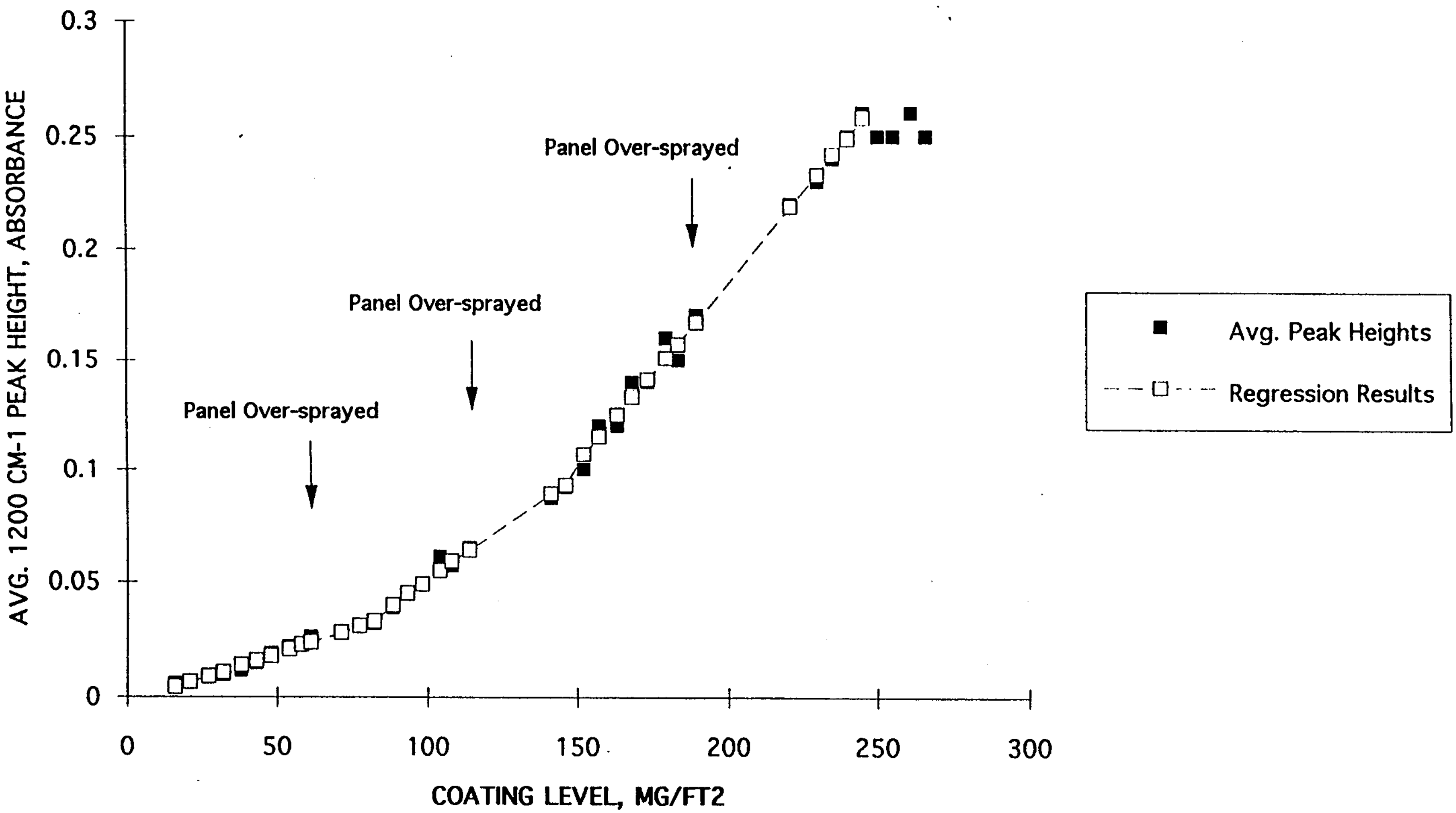
Scan parameters: 48 pulses per spectrum 16 cm-1 resolution. Results were average of five spectra per coating level. Correlation coefficient=0.97. AC80o/6/96

Figure 18: SOC-400 ANALYSIS RESULTS FROM ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS WITH ONE COATING LEVEL PER PANEL



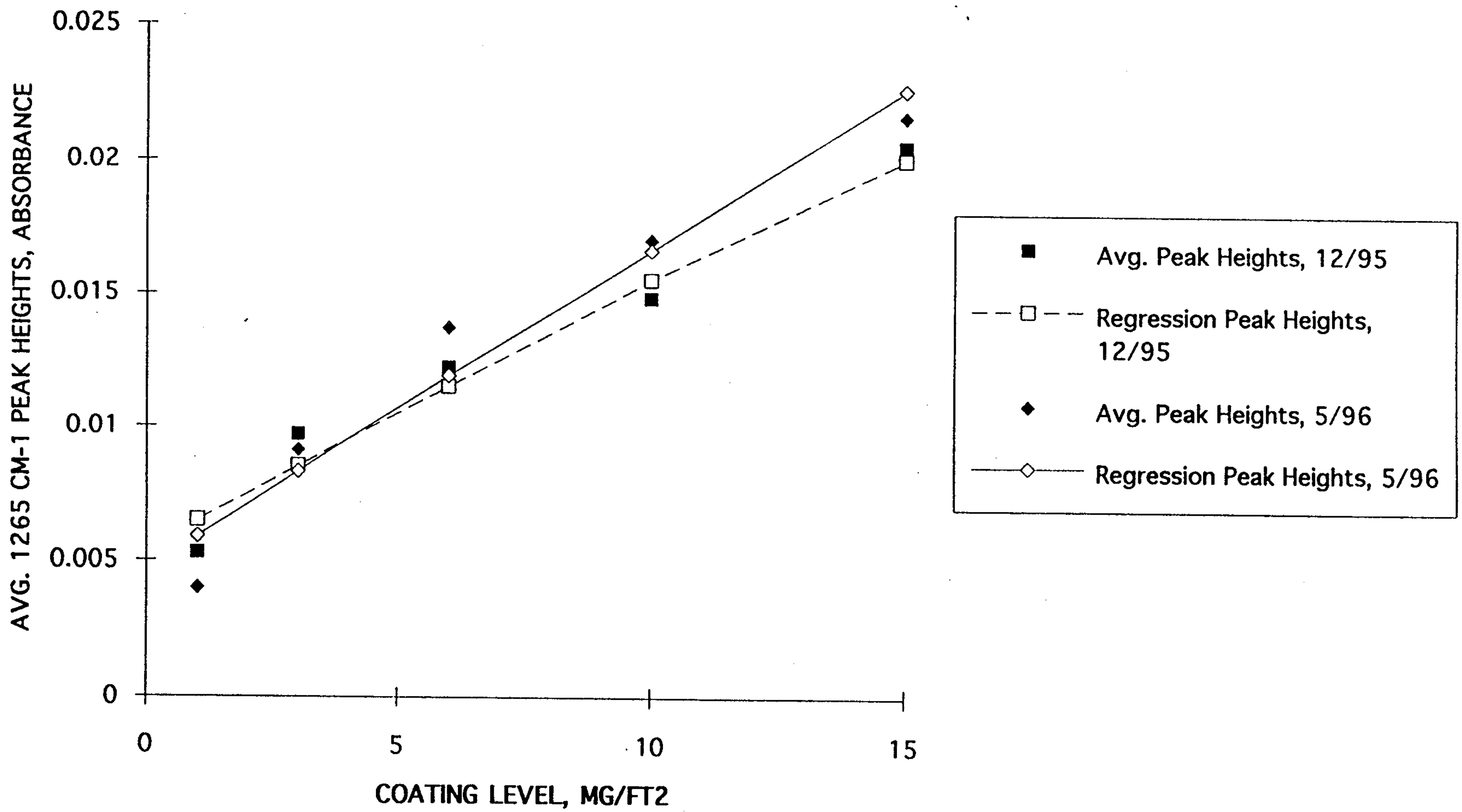
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of five spectra per coating level. Panel roughness=95 microinches. AC80k/6/96

Figure 19: RESULTS FROM SOC-400 ANALYSES OF ALUMINUM/FLUOROLUBE CONTAMINATION STANDARDS



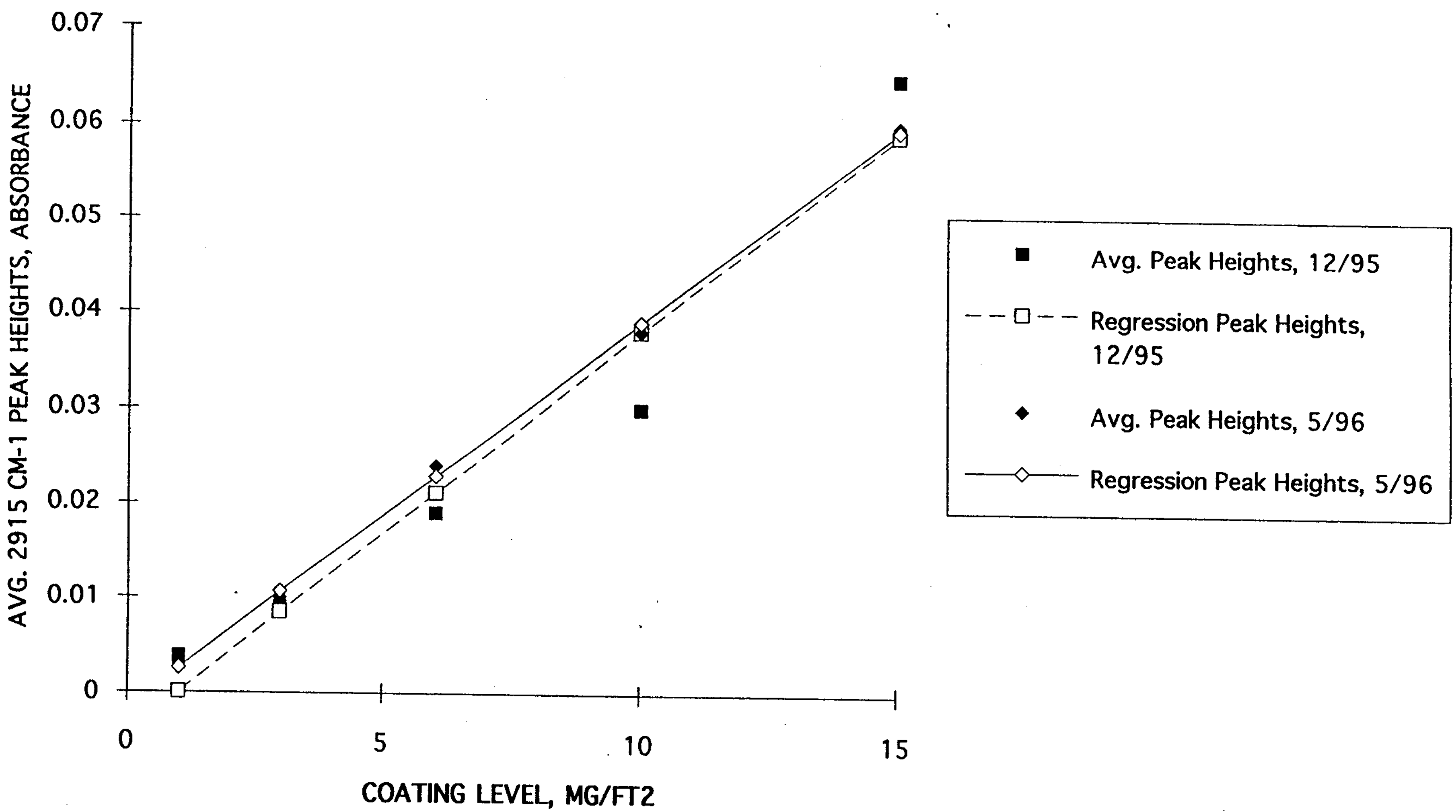
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. Panel roughness=112 microinches.
AC80j/6/96

Figure 20: COMPARISON OF SOC-400 CONTACT ANALYSIS RESULTS FROM ALUMINUM/CRC SILICONE CONTAMINATION STANDARDS



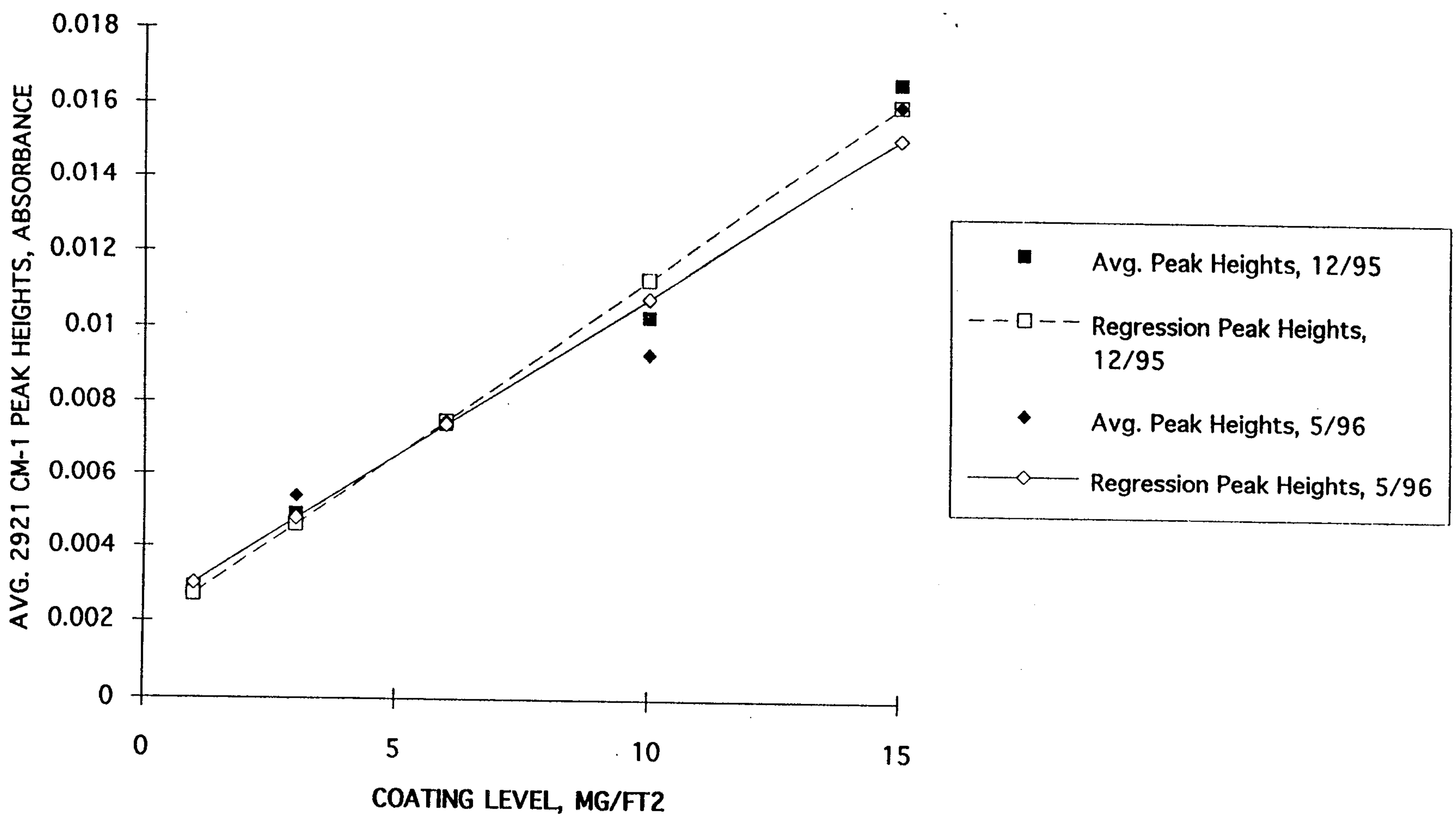
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. AC80r/6/96

Figure 21: COMPARISON OF SOC-400 CONTACT ANALYSIS RESULTS FROM ALUMINUM/PARAFFIN CONTAMINATION STANDARDS



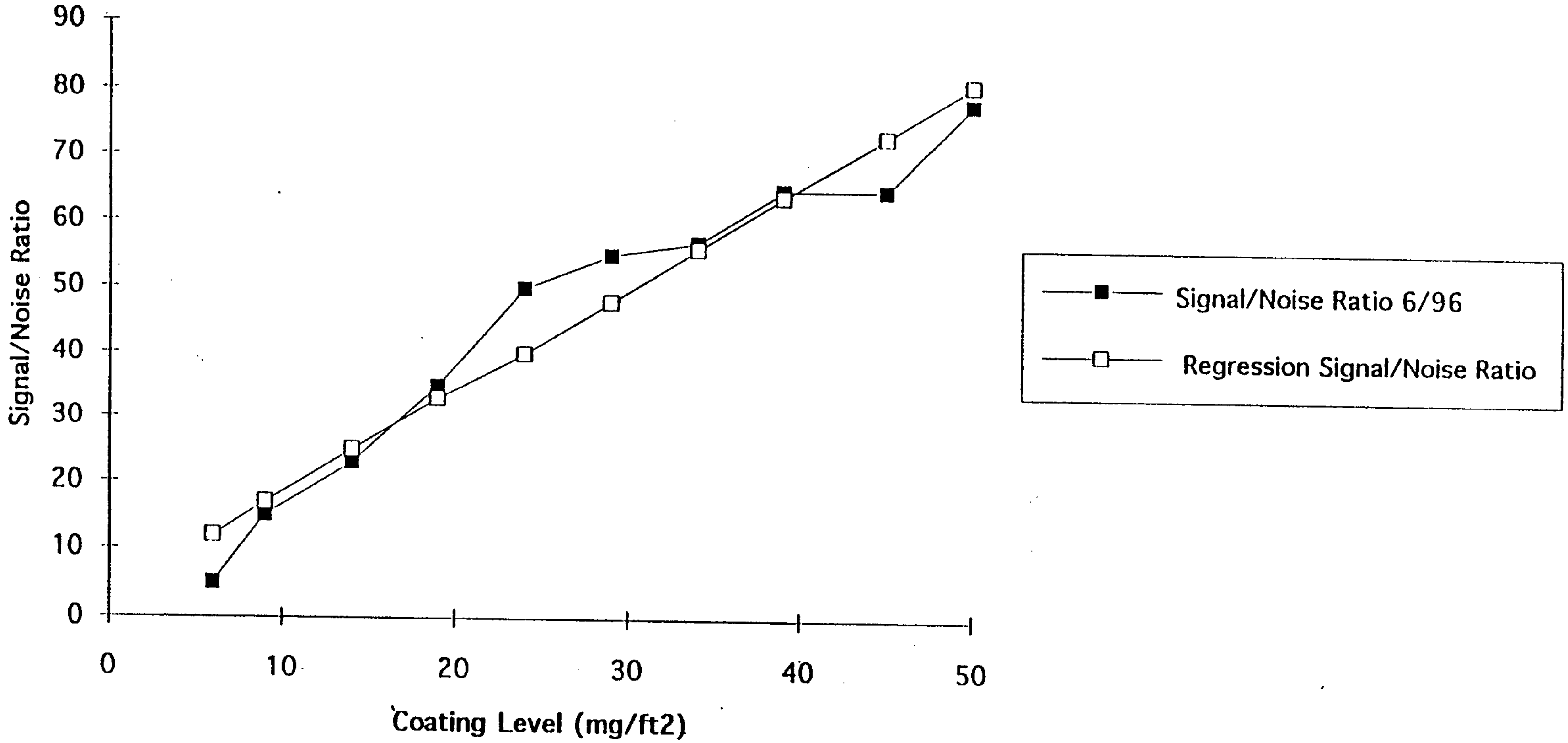
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. AC80q/6/96

Figure 22: COMPARISON OF SOC-400 CONTACT ANALYSIS RESULTS FROM ALUMINUM/TRI-FLOW CONTAMINATION STANDARDS



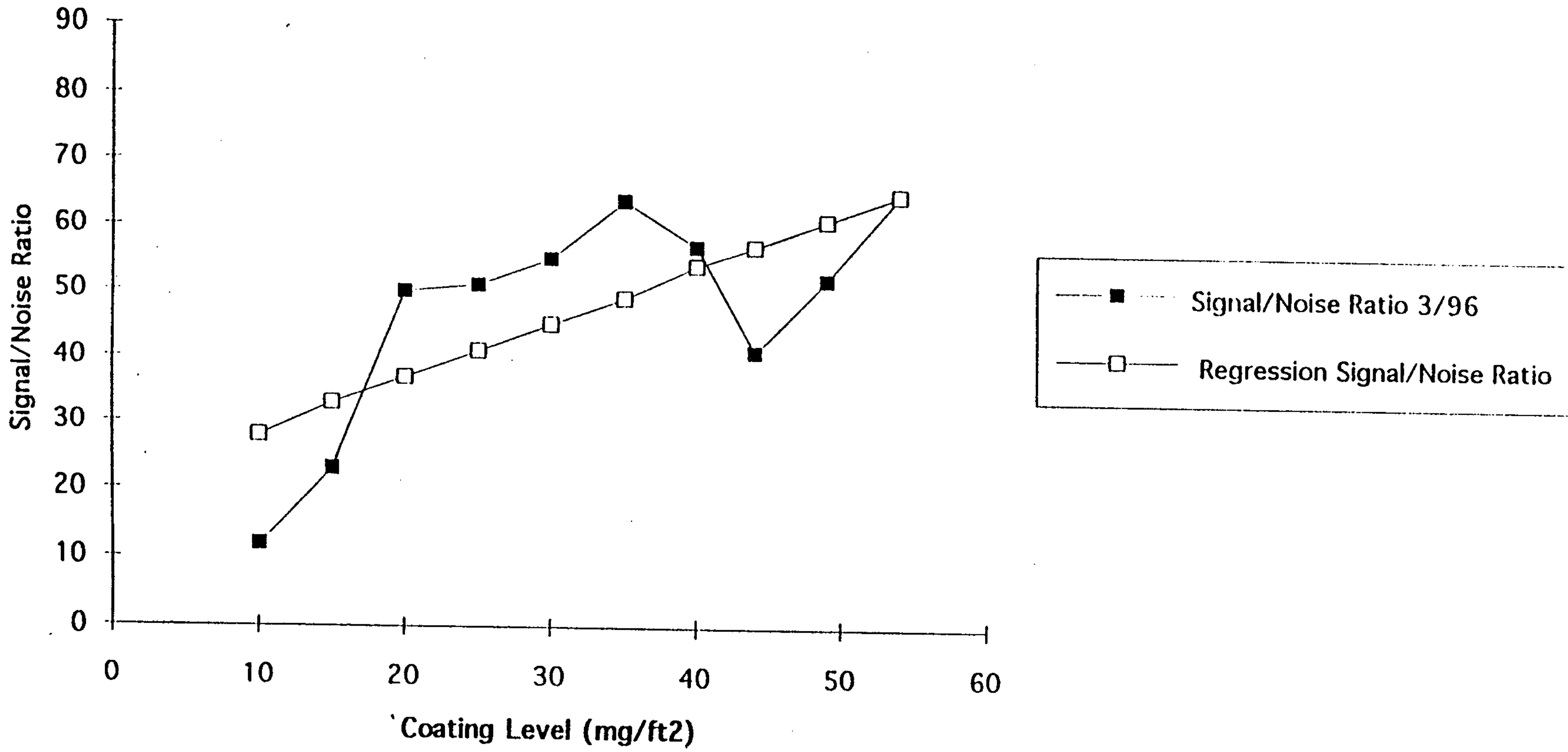
Scan parameters: 48 pulses, 16 cm-1 resolution. Average of three spectra minimum per coating level. AC80s/6/96

Figure 23: ANALYSIS OF SOC-400 SIGNAL/NOISE RATIO FOR PARAFFIN OVER 7075 ALUMINUM AFTER INSTRUMENT MODIFICATIONS



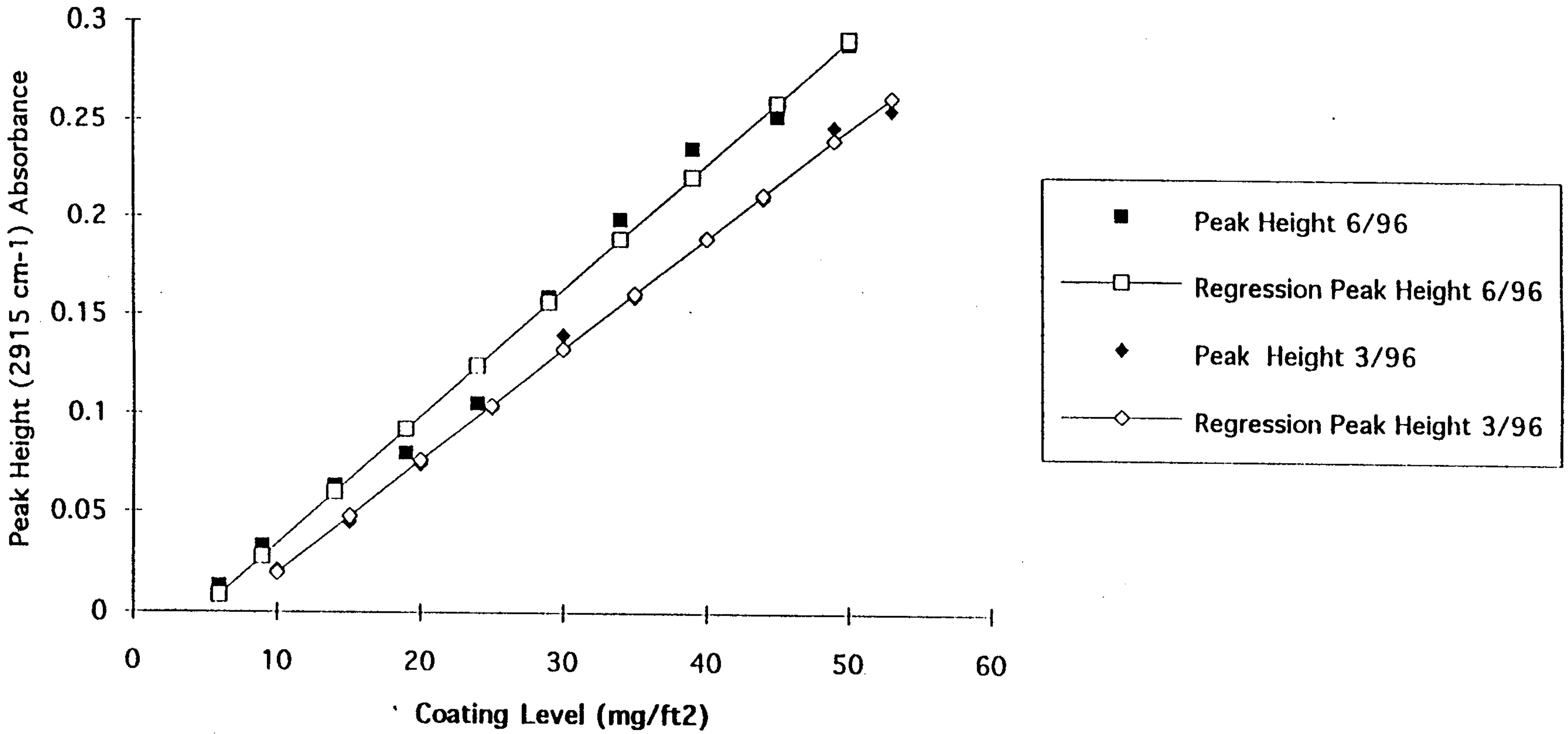
Parameters: Contact mode, 48 pulses per spectrum, 16 cm-1 resolution, Results were averages of three spectra per coating level. Correlation coefficient 0.94, Slope 1.56, Ra 101 micro-inches.

Figure 24: ANALYSIS OF SOC-400 SIGNAL/NOISE RATIO FOR PARAFFIN OVER 7075 ALUMINUM BEFORE INSTRUMENT MODIFICATIONS



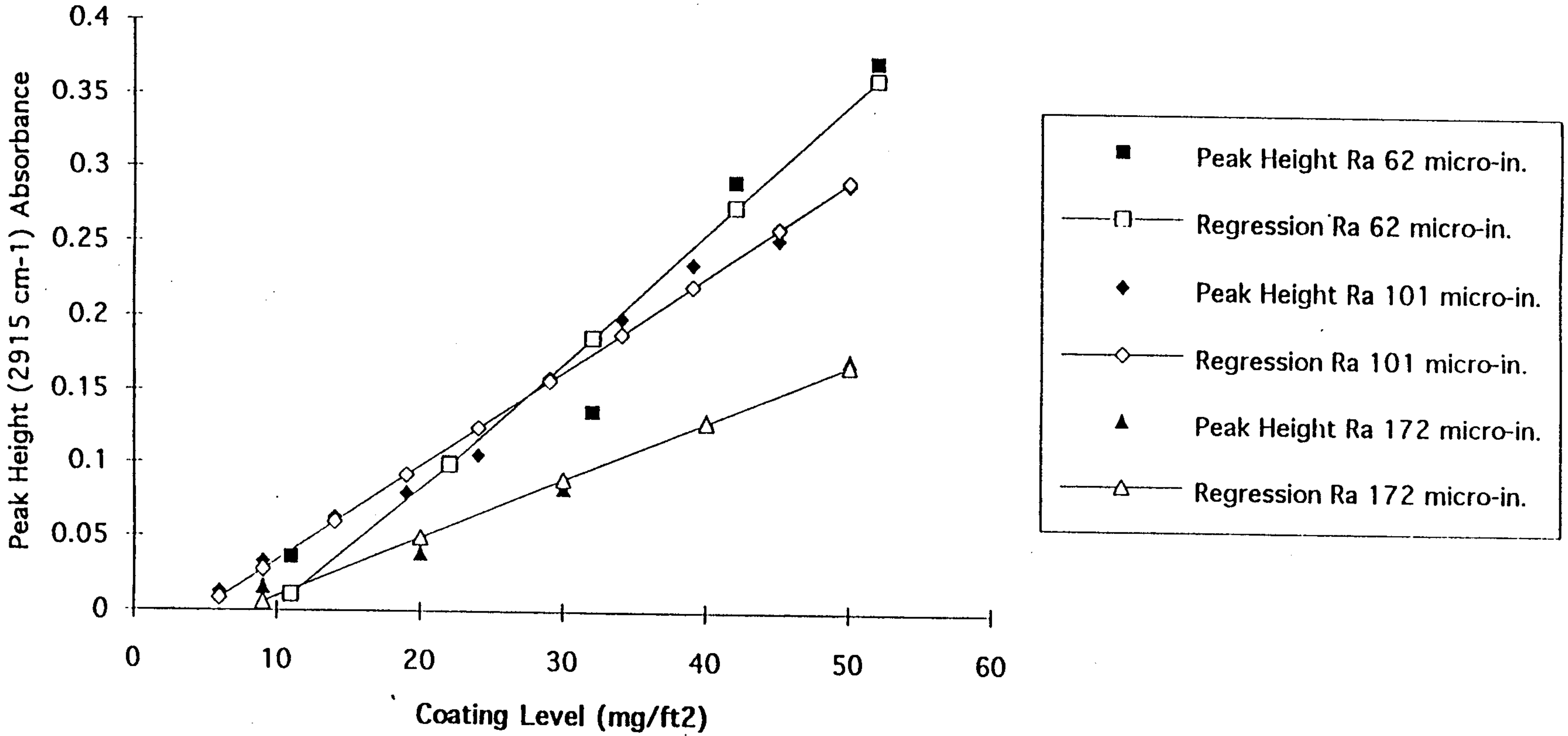
Parameters: Contact mode, 48 pulses per spectrum, 16 cm-1 resulution. Results were averages of three spectra per coating level. Correlation coefficient 0.51, Slope 0.84, Ra 110 micro-inches.

Figure 25: RESULTS OF SOC-400 CONTACT ANALYSIS OF PARAFFIN OVER 7075 ALUMINUM BEFORE AND AFTER INSTRUMENT MODIFICATIONS



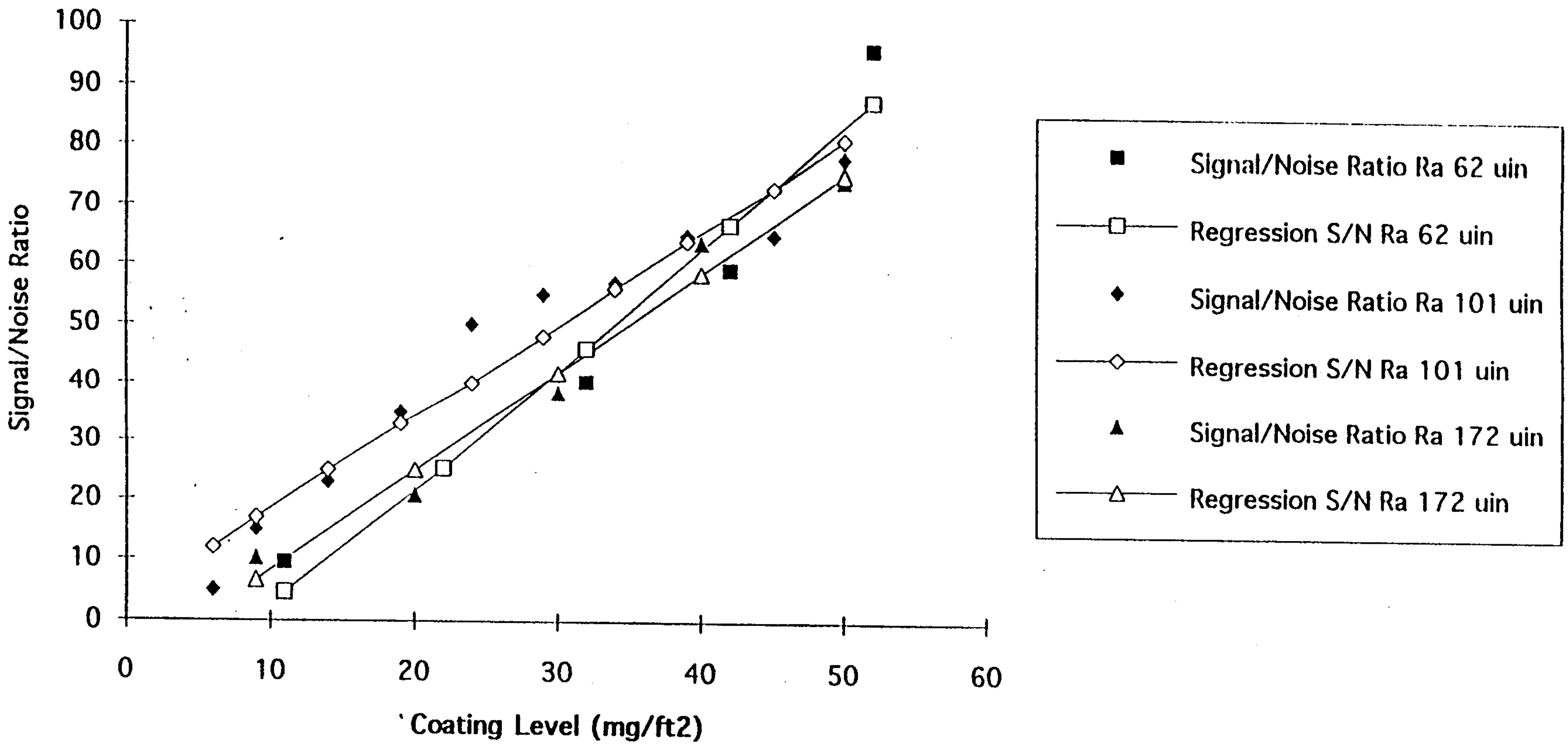
Parameters: 48 pulses per spectrum, 16 cm-1 resolution. Results are averages of three spectra per coating level. March: R2 0.99, slope .0057, Ra 110 uin. June: R2 0.99, slope .0064, Ra 101 uin.

Figure 26: SOC-400 CONTACT ANALYSIS OF ROUGHNESS EFFECT FOR PARAFFIN OVER 7075 ALUMINUM



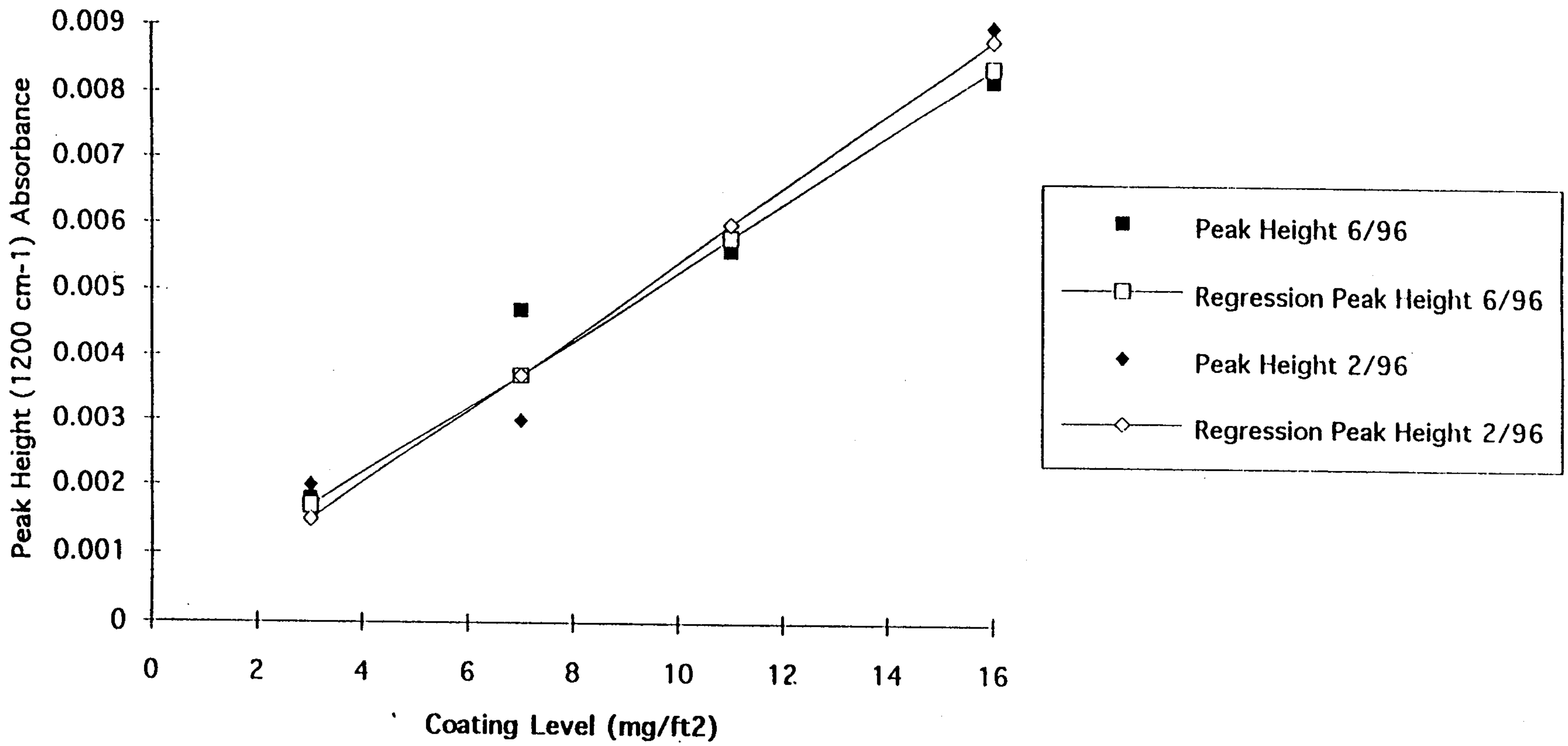
Parameters: 48 pulses per spectrum, 16 cm-1 resolution. Results are averages of three (min) spectra per coating level. Ra 62 uin: R2 0.96, slope .0088. Ra 101 uin: R2 0.99, slope .0064. Ra 172: uin: R2 0.98, slope .0037.

Figure 27: SOC-400 CONTACT ANALYSIS OF ROUGHNESS EFFECT ON SIGNAL/NOISE RATIOS FOR 7075 ALUMINUM/PARAFFIN STANDARD



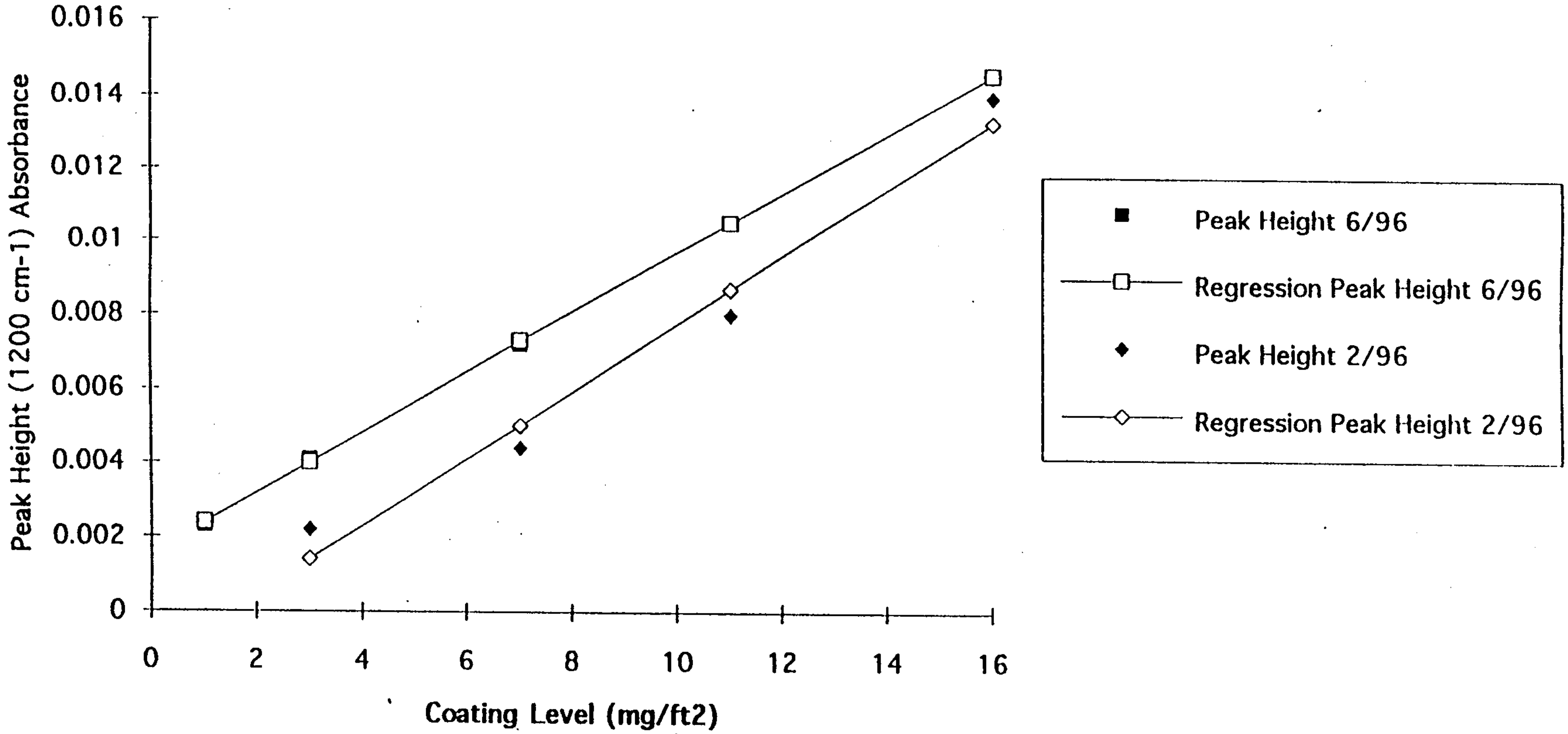
Parameters: Absorbance, 48 pulses per spectrum, 16 cm-1 resolution. Results were averages of three (min) spectra per coating level. Ra-62: R2=.96, X1= 2.07. Ra-101: R2=.94, X1= 1.56. Ra-172: R2=.98, X1= 1.67.

Figure 28: SOC-400 CONTACT ANALYSIS OF FLUOROLUBE OVER 7075 ALUMINUM BEFORE AND AFTER INSTRUMENT MODIFICATIONS



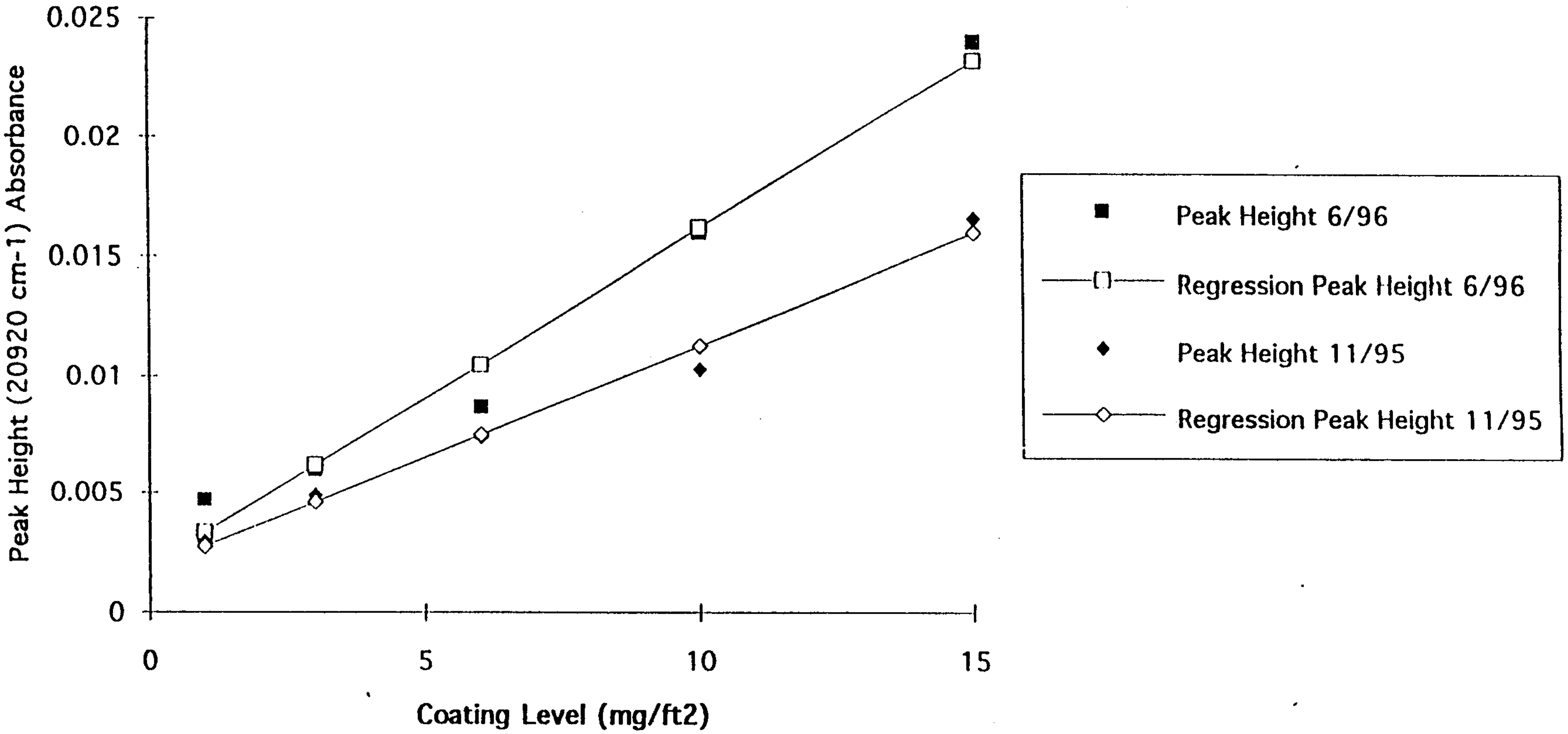
Parameters: 48 pulses per spectrum, 16 cm-1 resolution. Results were averages of three spectra per coating level. June '96: R2 = .99, slope = .00052. Feb. '95: R2 = .97, slope = .00056.

Figure 29: SOC-400 CONTACT ANALYSIS OF FLUOROLUBE OVER D6AC STEEL BEFORE AND AFTER INSTRUMENT MODIFICATIONS



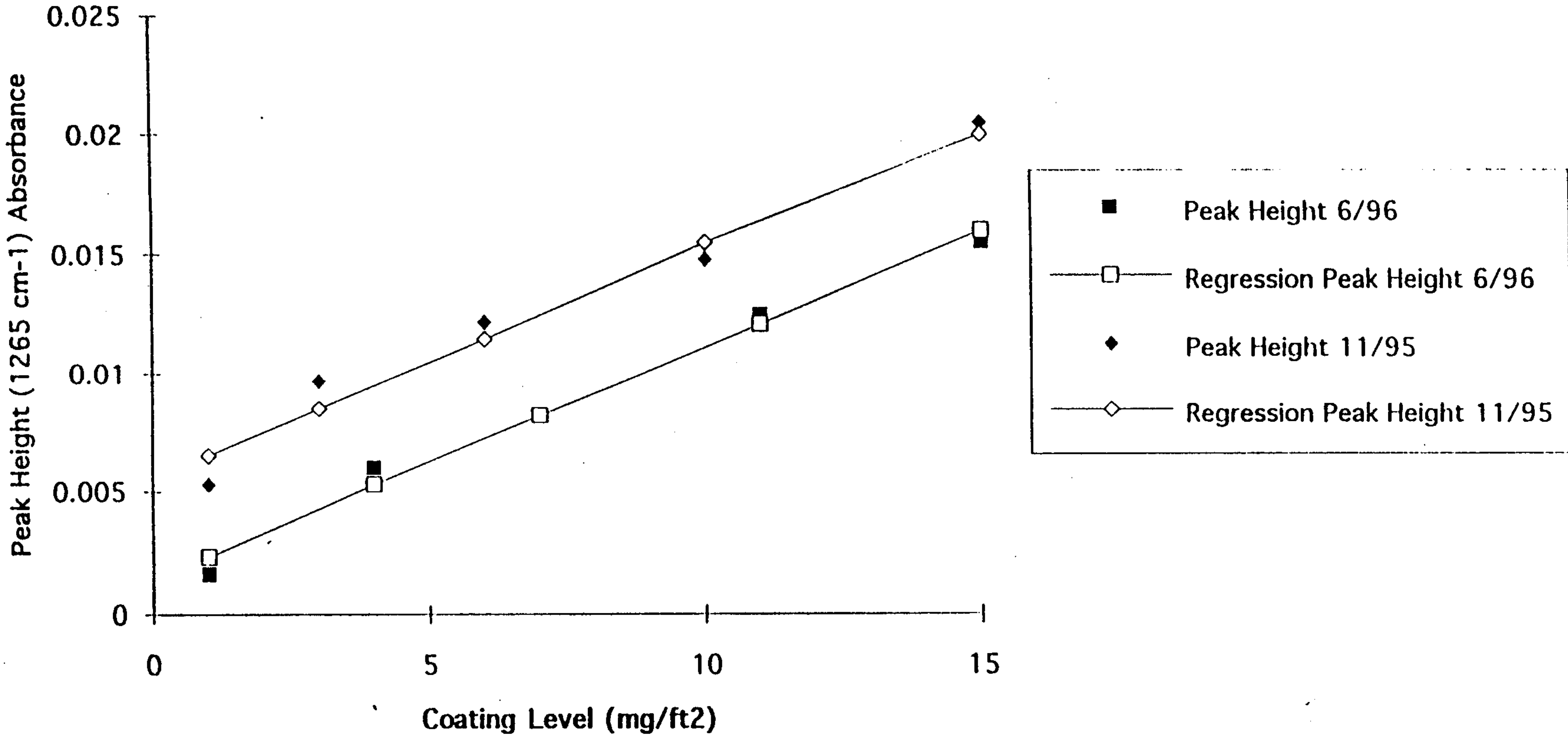
Parameters: 48 pulses pe spectrum, 16 cm-1 resolution. Results were averages of three spectra per coating level. June '96: R2 = .99+, slope = .00082. Feb. '96: R2 = .97, slope = .0009.

Figure 30: SOC-400 CONTACT ANALYSIS OF TEFLON OVER 7075 ALUMINUM BEFORE AND AFTER INSTRUMENT MODIFICATIONS



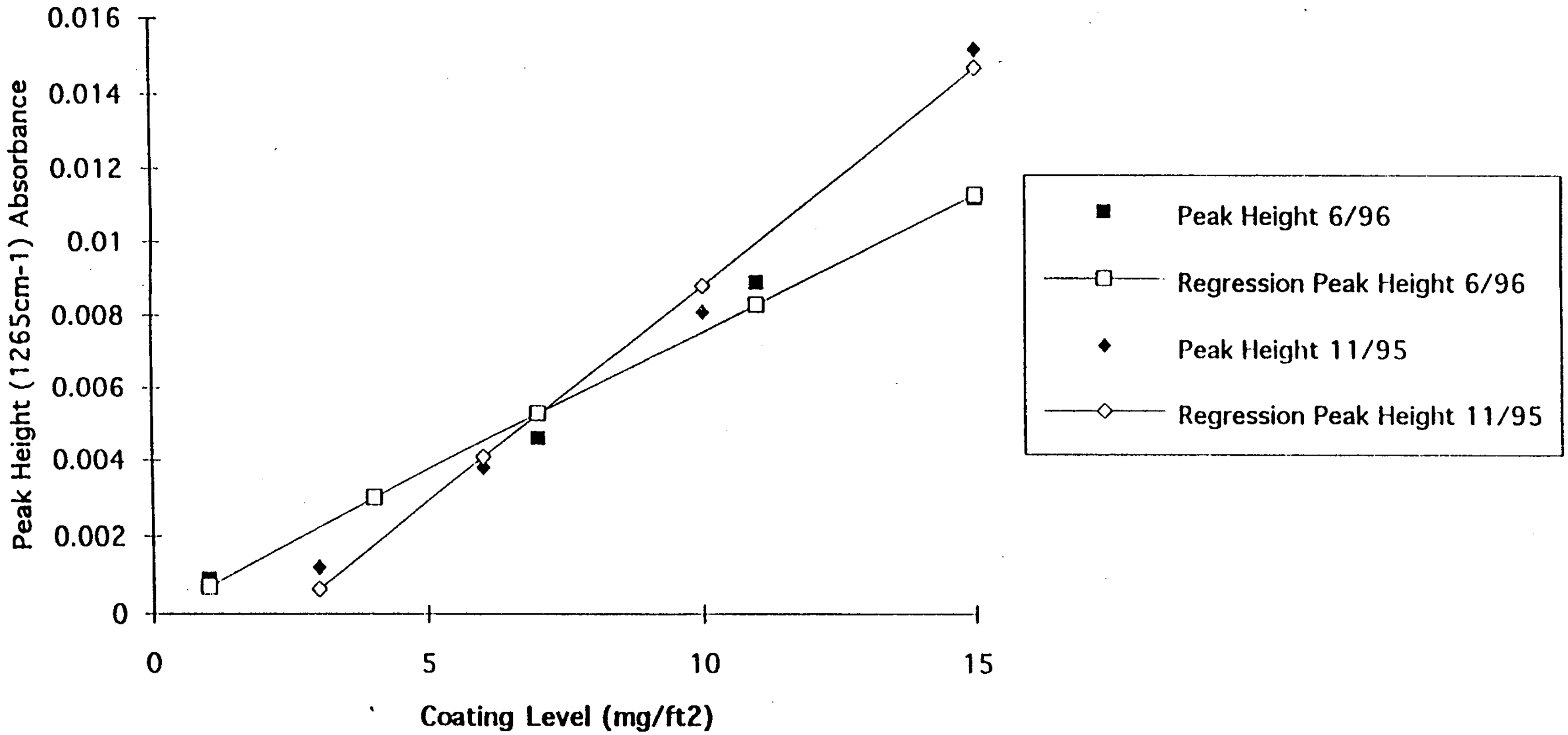
Parameters: 48 pulses per spectrum, 16 cm-1 resolution. Results were averages of three spectra per coating level. June '96: R2 = .98, slope = .0014. Nov. '95: R2 = .99, slope = .00095.

Figure 31: SOC-400 CONTACT ANALYSIS OF CRC SILICONE OVER 7075 ALUMINUM BEFORE AND AFTER INSTRUMENT MODIFICATIONS



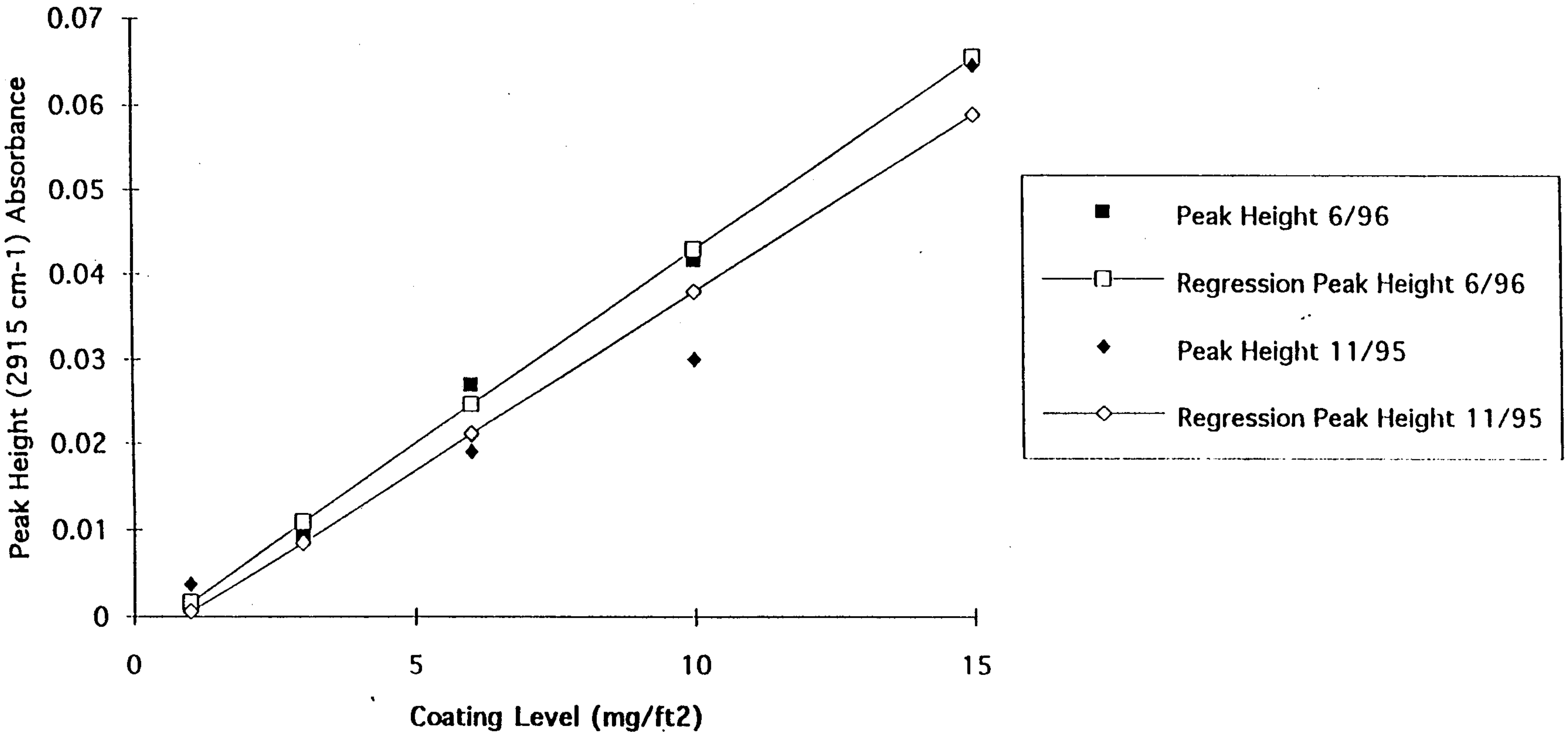
Parameters: 48 pulses per spectrum, 16 cm-1 resolution. Results were avgs of 3 spectra per coating level. 6/96: R2 = .99, slope = .0?1. 11/95: R2 - .97, slope = .001. June peaks derrived from SOC spectra analyzed by Nicolet software.

Figure 32: SOC-400 CONTACT ANALYSIS OF CRC SILICONE OVER D6AC STEEL BEFORE AND AFTER INSTRUMENT MODIFICATIONS



Parametes: 48 pulses per spectrum, 16 cm-1 resolution. Results were avgs of 3 spectra per coating level. 6/96: R2 = .99, slope = .0008. 11/95: R2 = .98, slope = .0012. June peaks derrived from SOC spectra analyzed by Nicolet software.

Figure 33: SOC-400 CONTACT ANALYSIS OF PARAFFIN OVER 7075 ALUMINUM BEFORE AND AFTER INSTRUMENT MODIFICATIONS



Parameters: 48 pulses per spectrum, 16 cm-1 resolution. Results were averages of three spectra per coating level. June '96: $R2 = .99+$ slope = .0046. Nov. '95: $R2 = .95$, slope = .0042.

Figure 3-? : JOC-400 CONTACT ANALYSIS OF EXTRACT FROM INSIDE SURFACE OF PLASTIC DISK BOX USED TO STORE STANDARDS

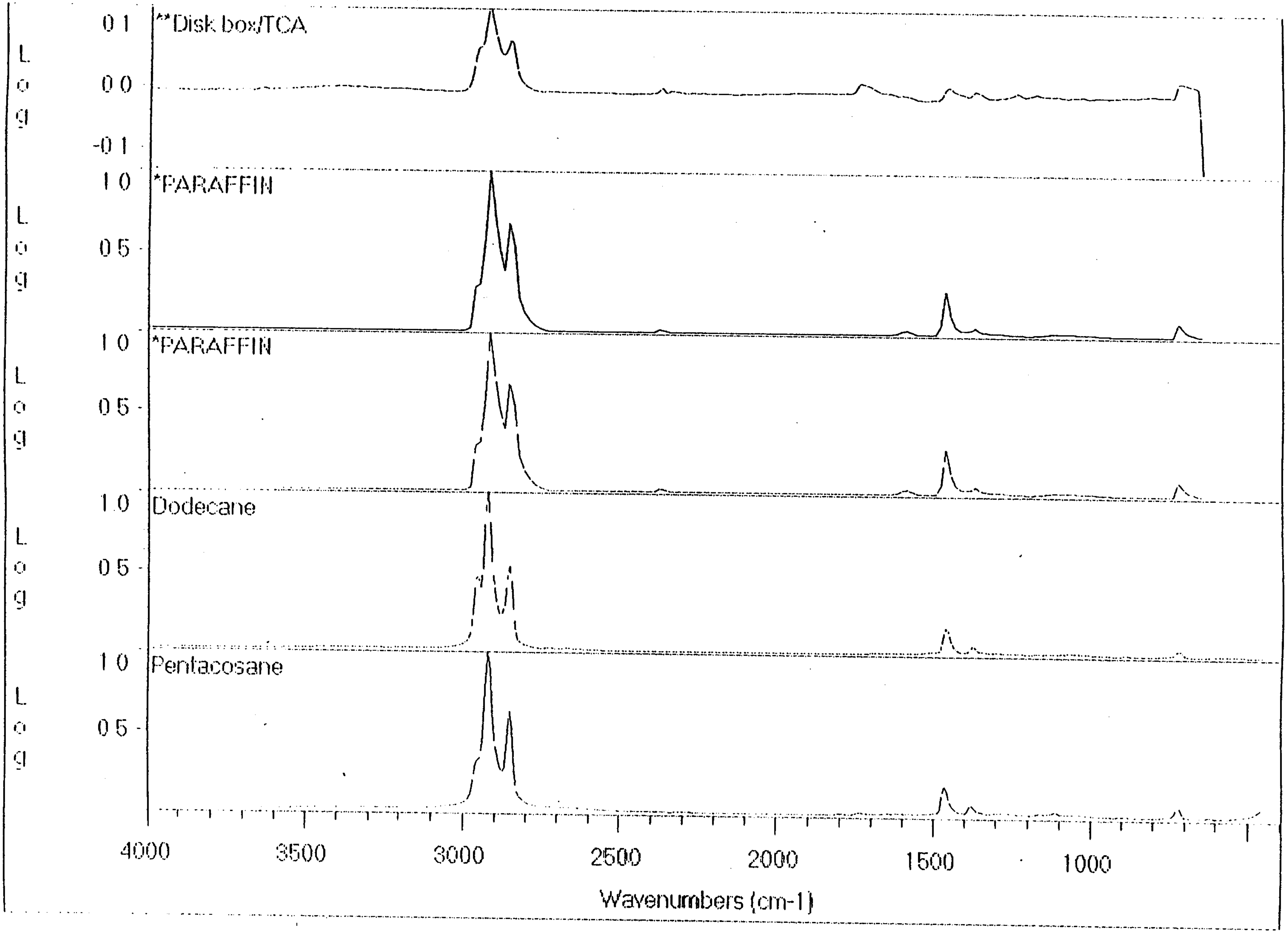


Figure 35: SOC-400 CONTACT ANALYSIS OF EXTRACT FROM INSIDE SURFACE OF PLASTIC DISK BOX USED TO STORE STANDARDS

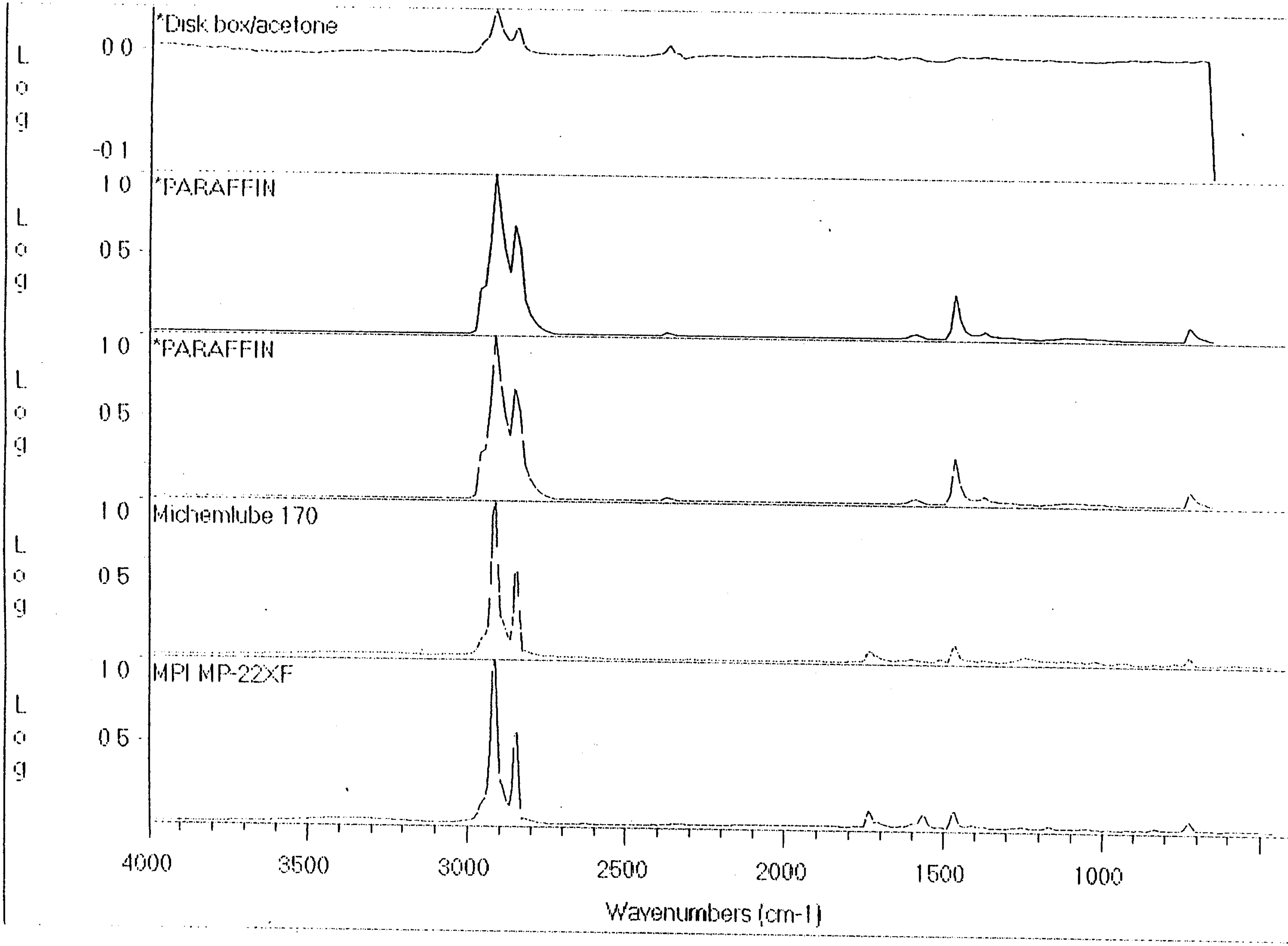
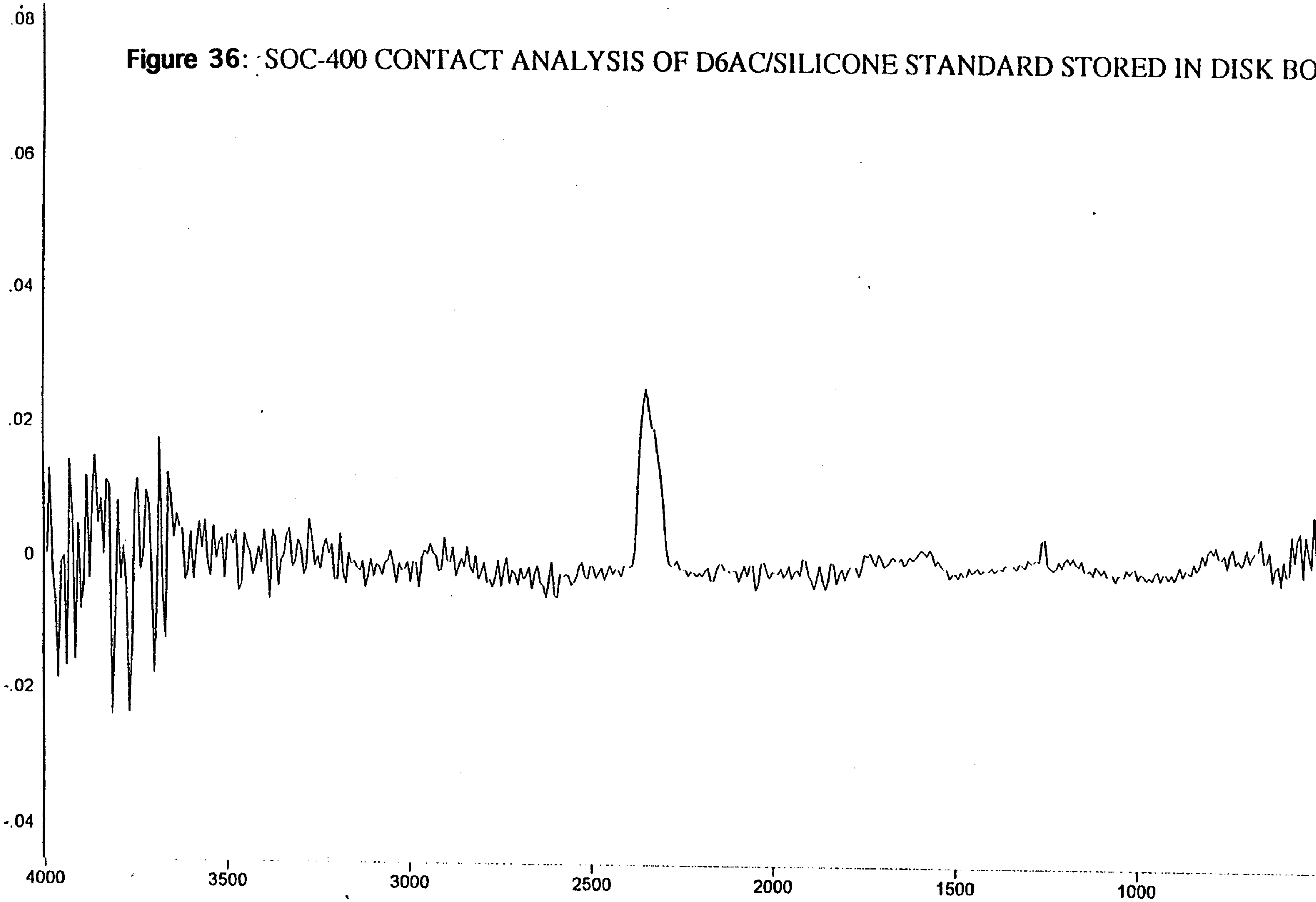


Figure 36: SOC-400 CONTACT ANALYSIS OF D6AC/SILICONE STANDARD STORED IN DISK BOX



Absorbance / Wavenumber (cm-1)

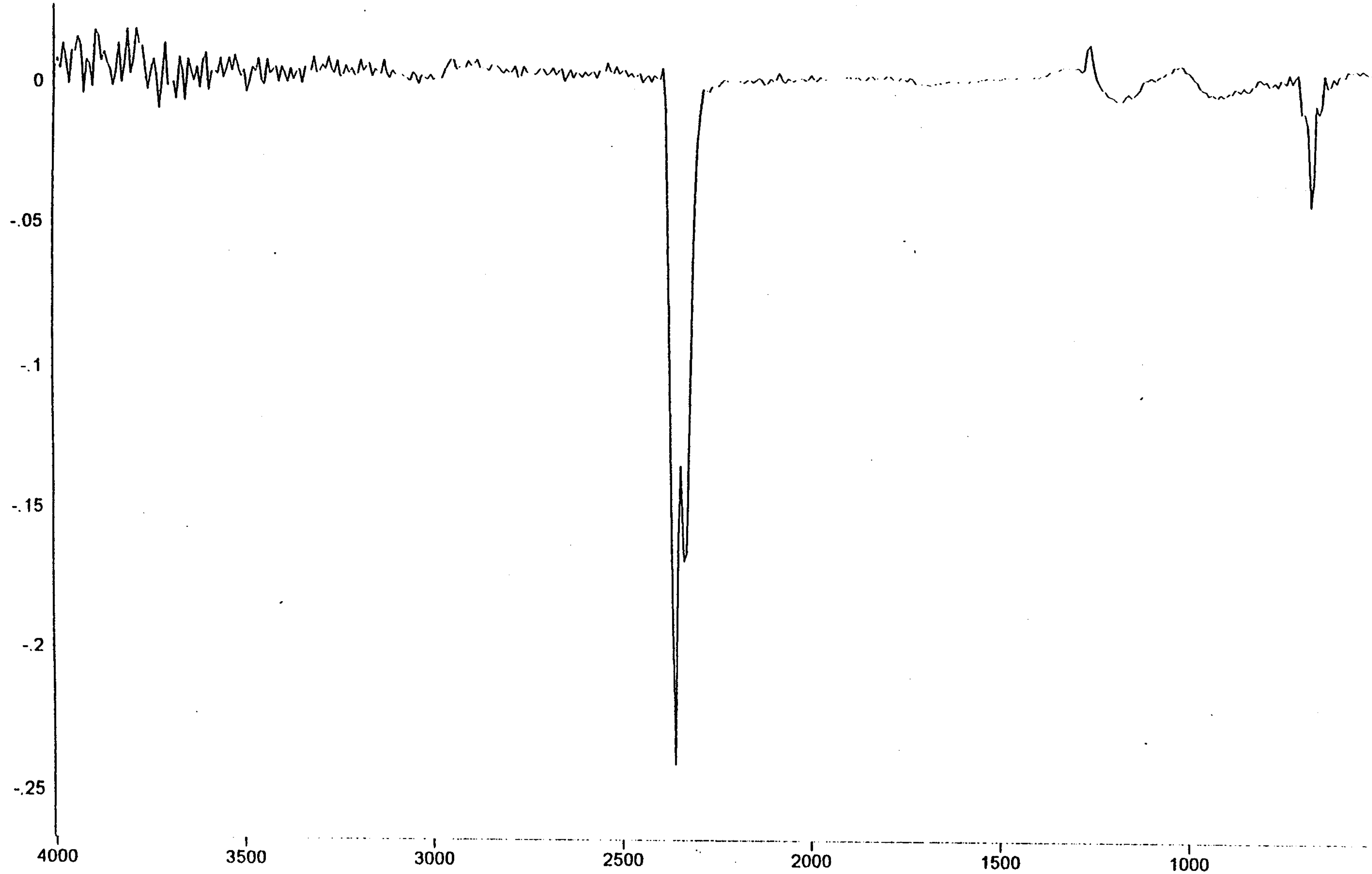
D6AC Steel coated with 4 mg/ft2 of Silicone.

Contact mode, 16 cm-1

Paged Y-Zoom CURSOR

7/23/96 4:02 PM Res=16 cm-1

Figure 37: SOC-400 CONTACT ANALYSIS OF ALUMINUM/SILICONE STANDARD STORED IN DISK BOX



Absorbance / Wavenumber (cm-1)

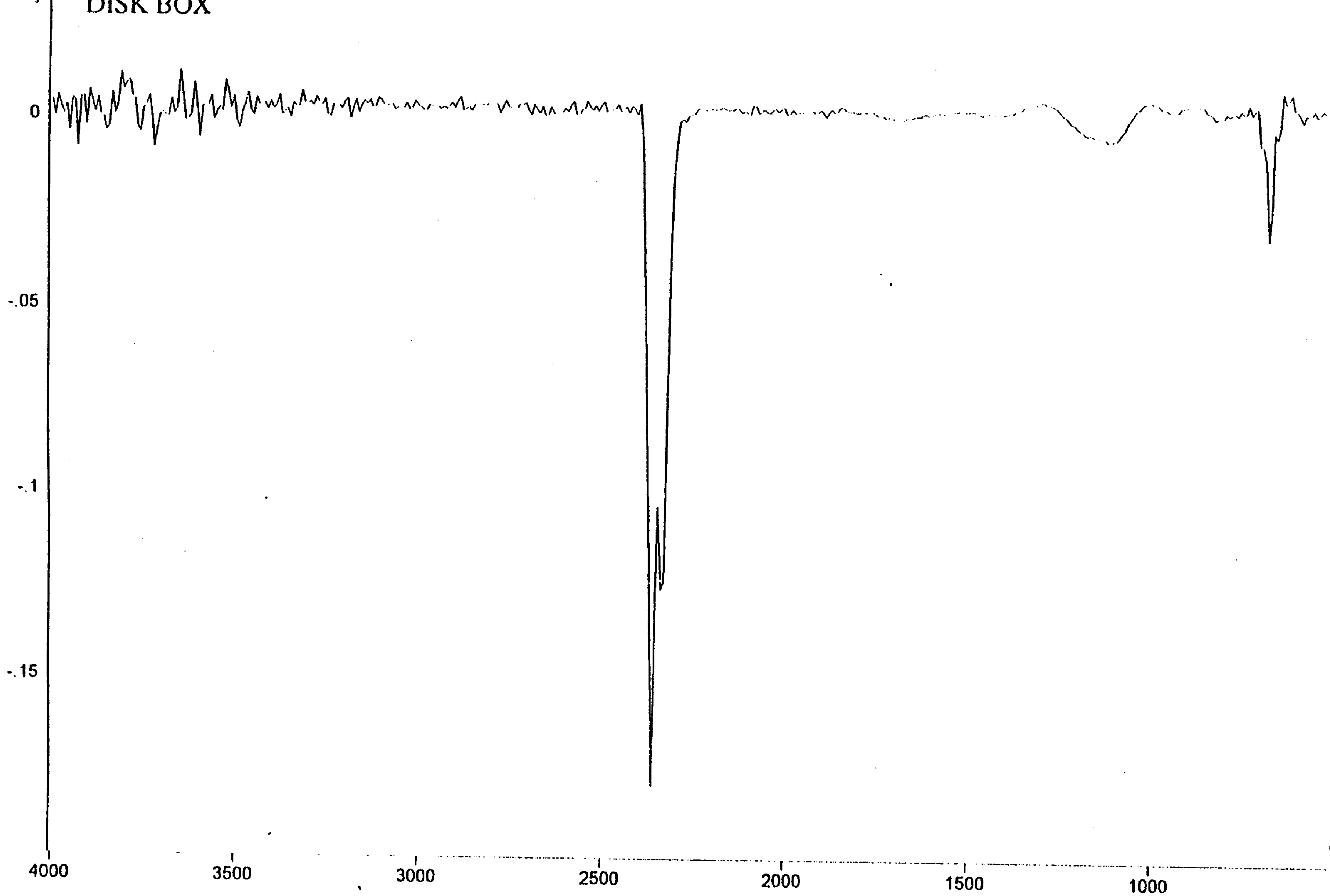
Aluminum coated with 11 mg/ft2 of Silicone.

Contact mode, 16 cm-1

Paged Y-Zoom CURSOR

7/24/96 9:51 AM Res=16 cm-1

Figure 38 : SOC-400 CONTACT ANALYSIS OF ALUMINUM/FLUOROLUBE STANDARD STORED IN DISK BOX



Absorbance / Wavenumber (cm-1)

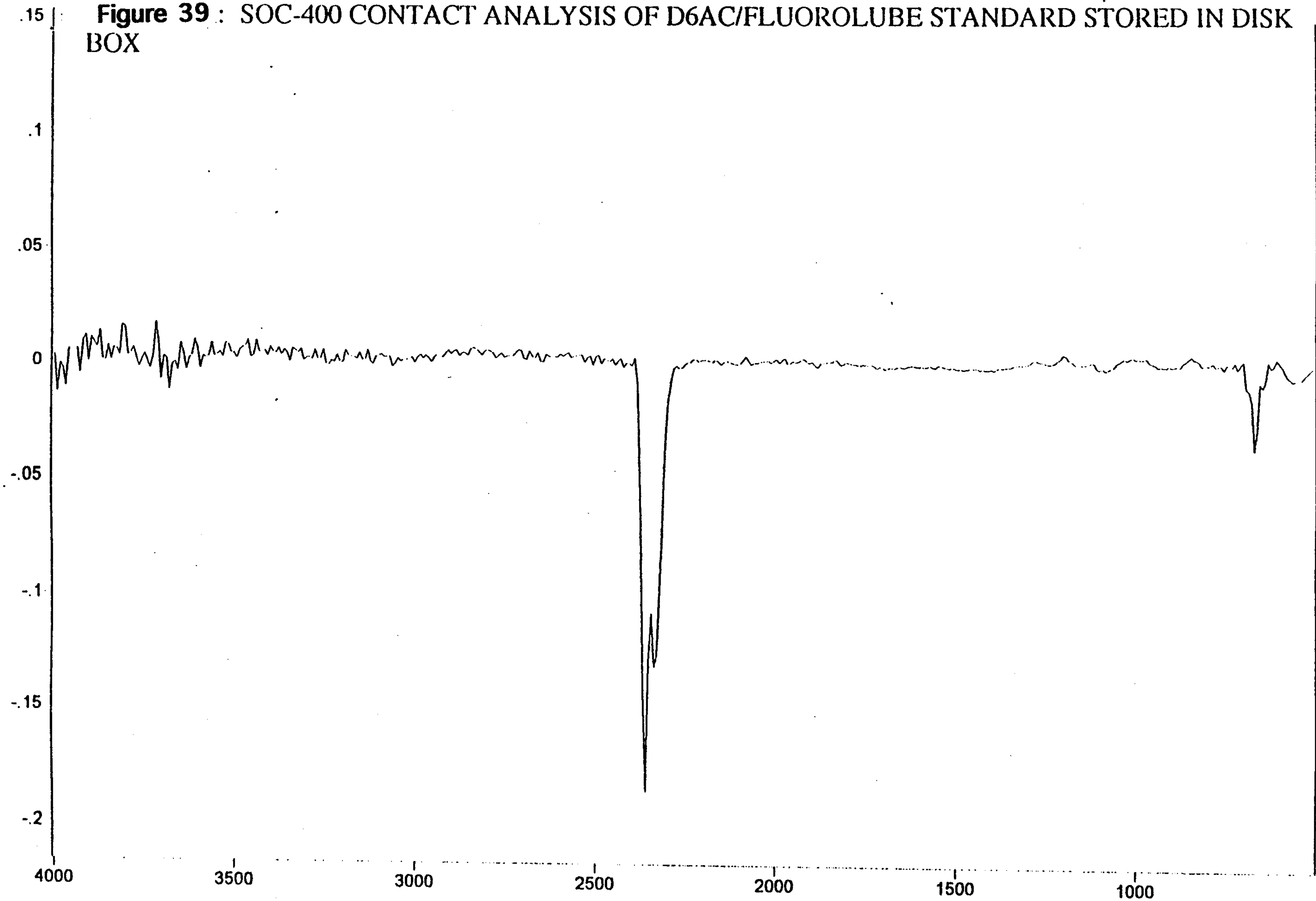
Aluminum coated with 0 mg/ft2 of Fluorolube.

Contact mode, 16 cm-1

Paged Y-Zoom CURSOR

7/24/96 9:58 AM Res=16 cm-1

Figure 39 : SOC-400 CONTACT ANALYSIS OF D6AC/FLUOROLUBE STANDARD STORED IN DISK BOX



.bsorbance / Wavenumber (cm-1)

Paged Y-Zoom CURSOR

)6AC Steel coated with 16 mg/ft2 of Fluorolube.

7/24/96 10:39 AM Res=16 cm-1

:ontact mode, 16 cm-1

Figure 40

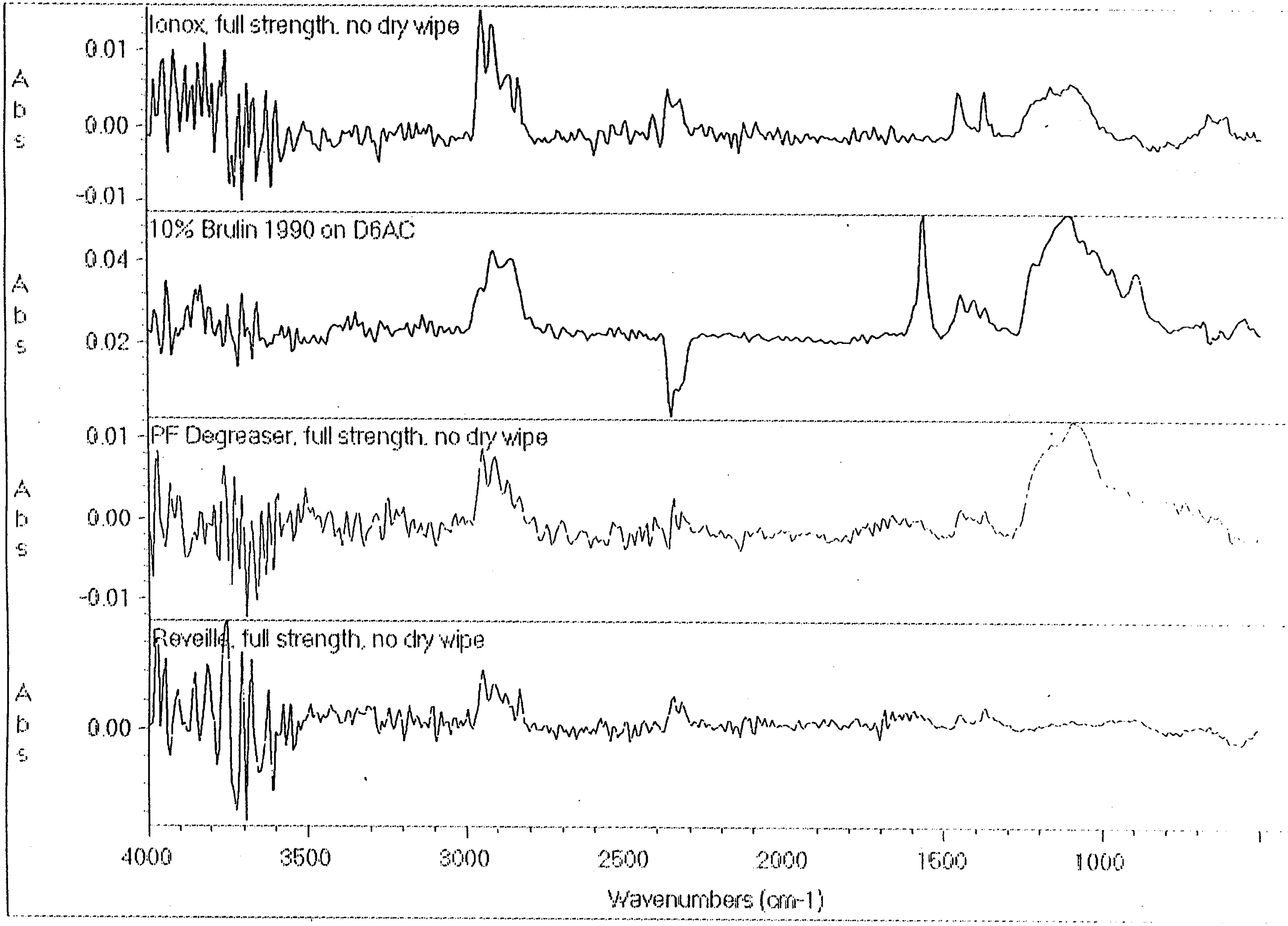
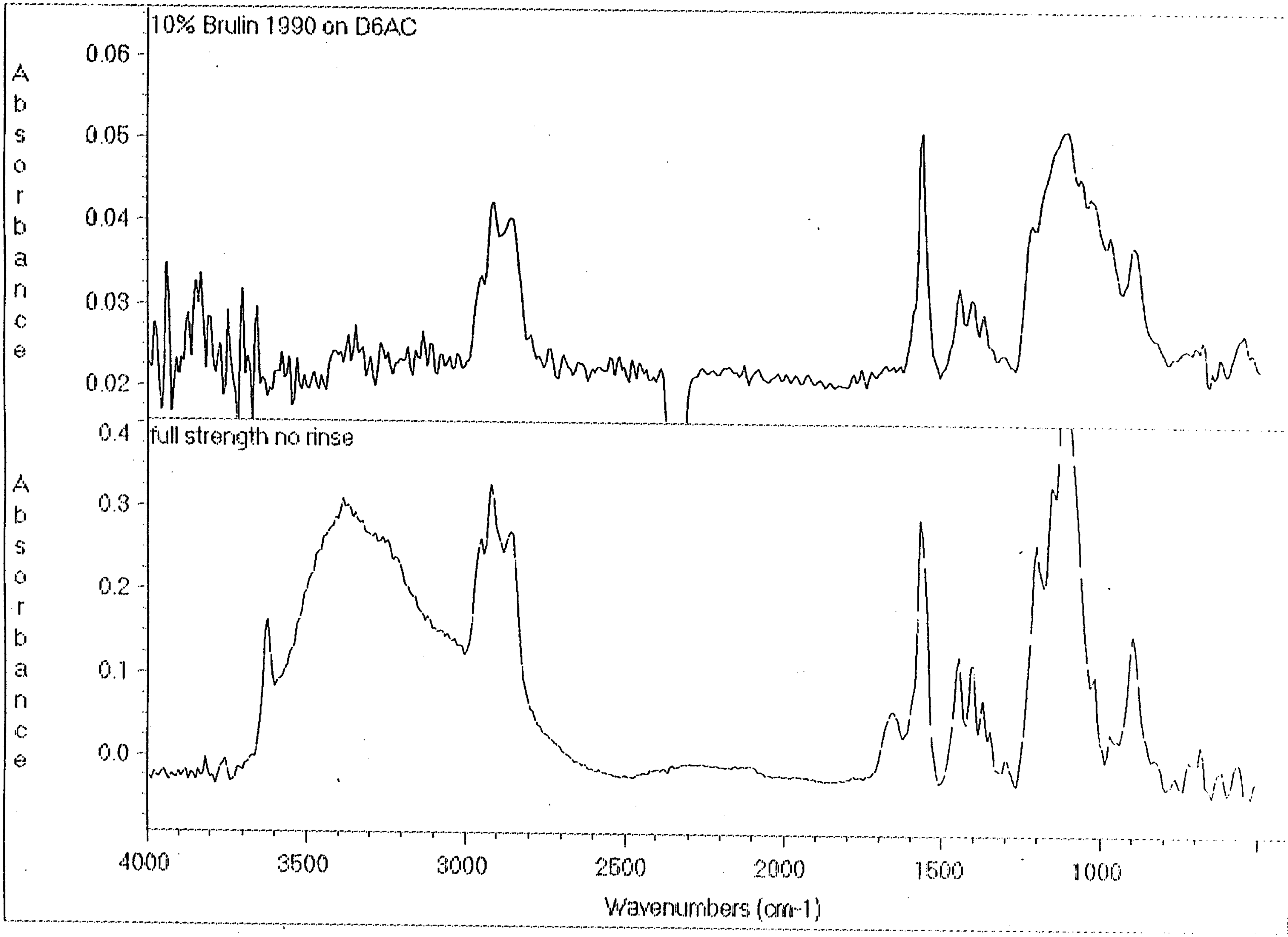

Ionox, full strength, no dry wipe
10% Brulin 1990 on D6AC
PF Degreaser, full strength, no dry wipe
Reveille, full strength, no dry wipe
Abs
0.01
0.00
-0.01
0.04
0.02
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 41



10% Brulin 1990 on D6AC
0.06
0.05
0.04
0.03
0.02
Absorbance
0.4
full strength no rinse
0.3
0.2
0.1
0.0
Absorbance
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 42

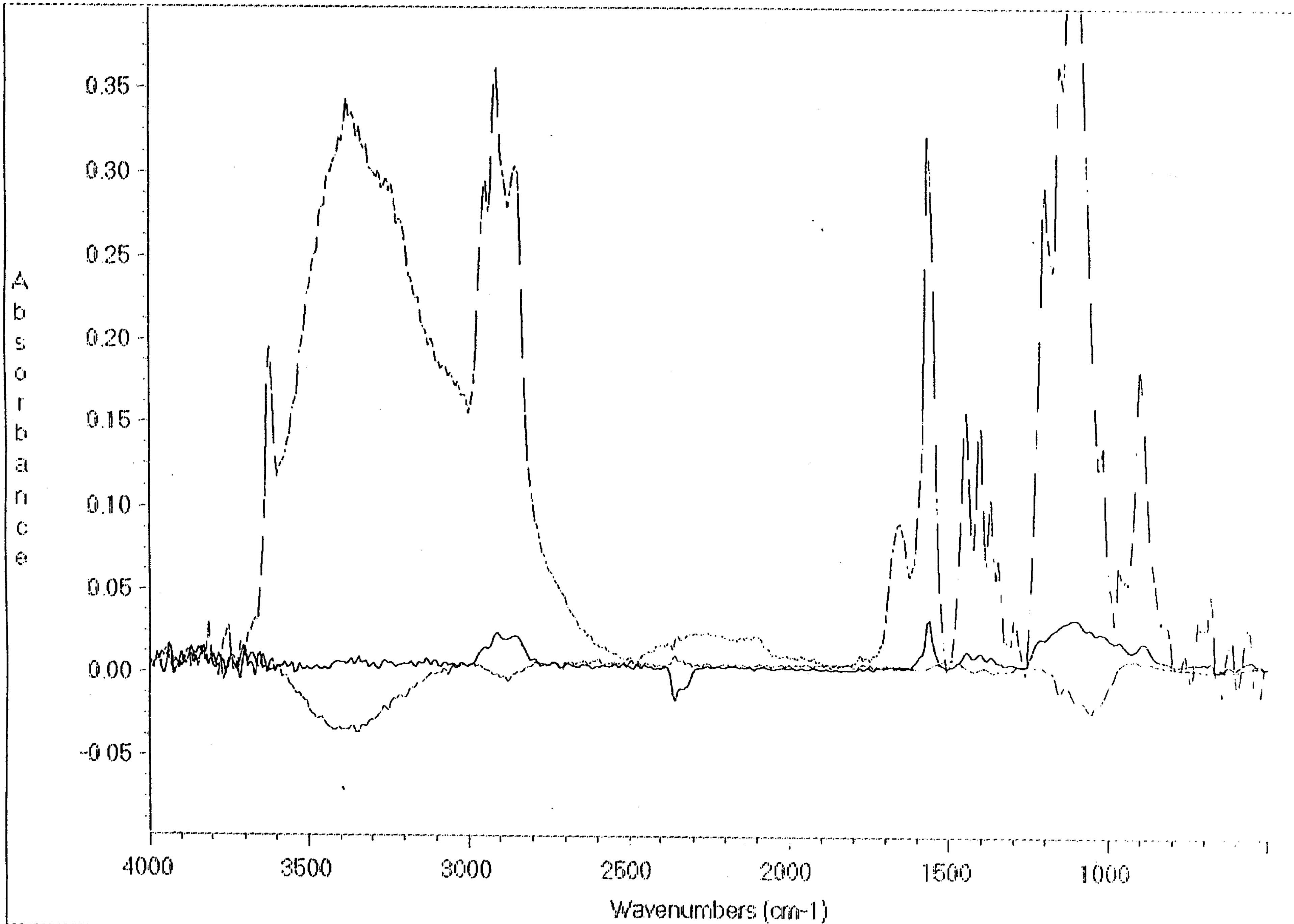
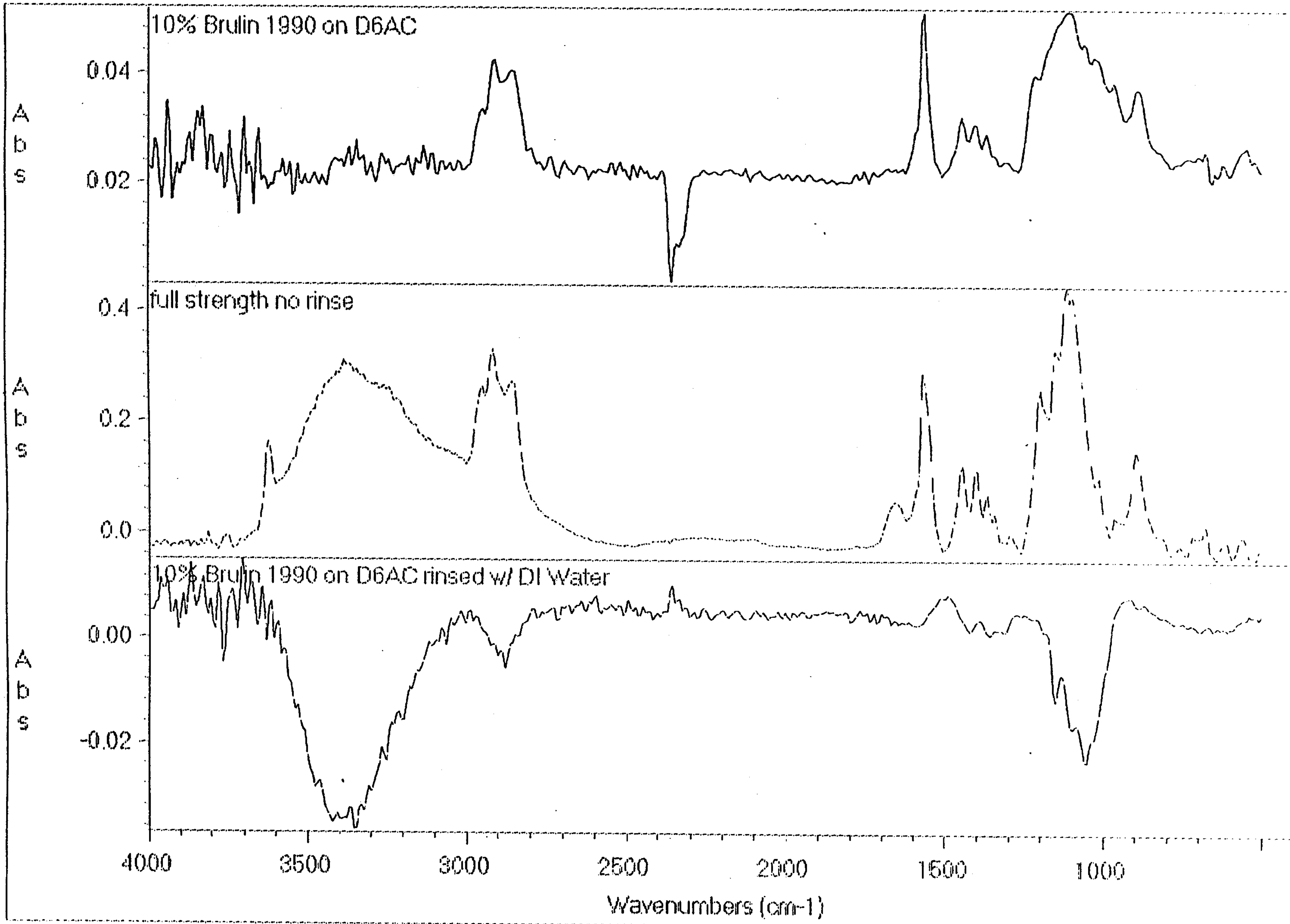
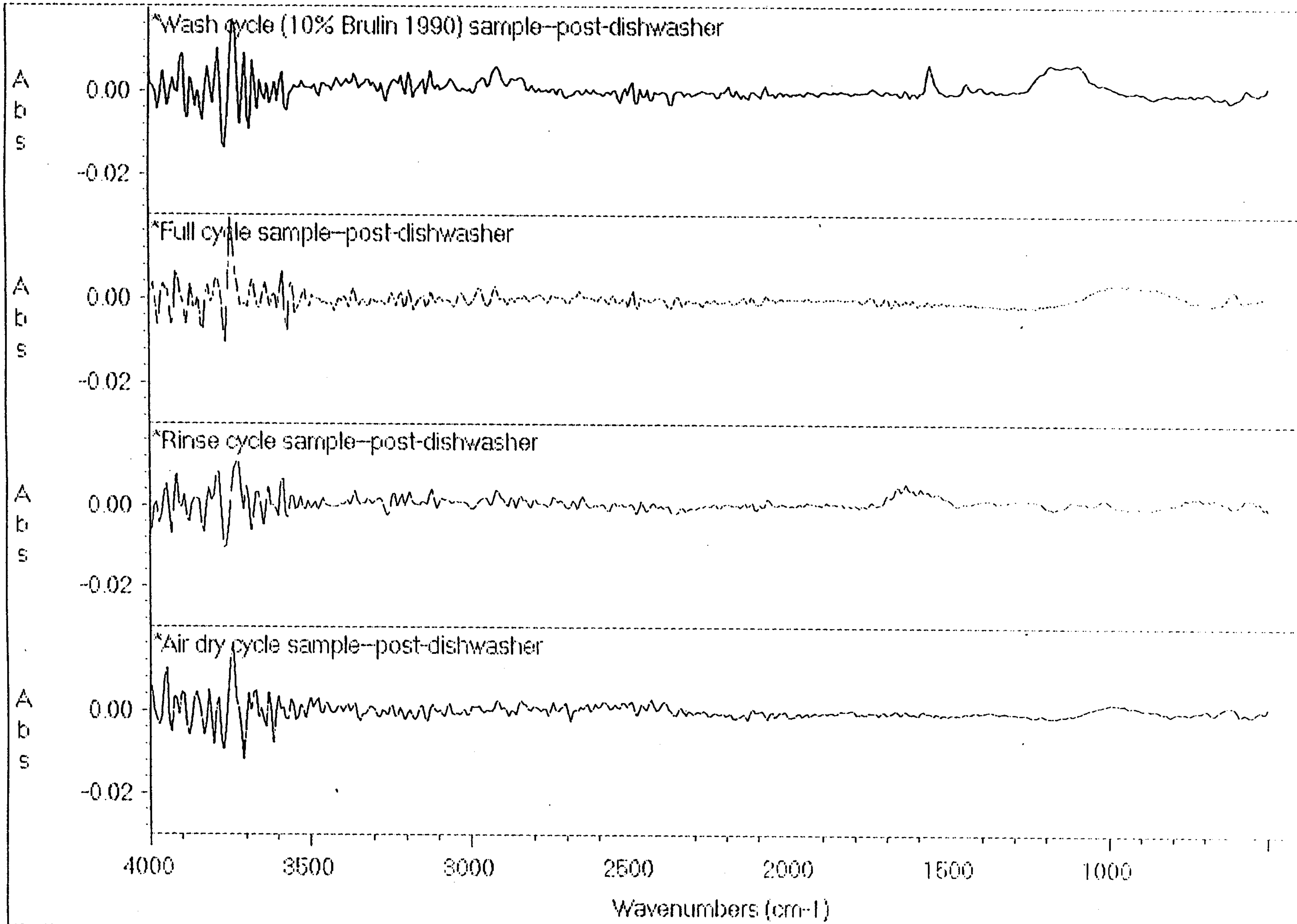

Absorbance
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 43



10% Brulin 1990 on D6AC
full strength no rinse
10% Brulin 1990 on D6AC rinsed w/ DI Water
Abs
0.04
0.02
0.4
0.2
0.0
0.00
-0.02
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 44



*Wash cycle (10% Brulin 1990) sample--post-dishwasher
*Full cycle sample--post-dishwasher
*Rinse cycle sample--post-dishwasher
*Air dry cycle sample--post-dishwasher
Abs
0.00
-0.02
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 45

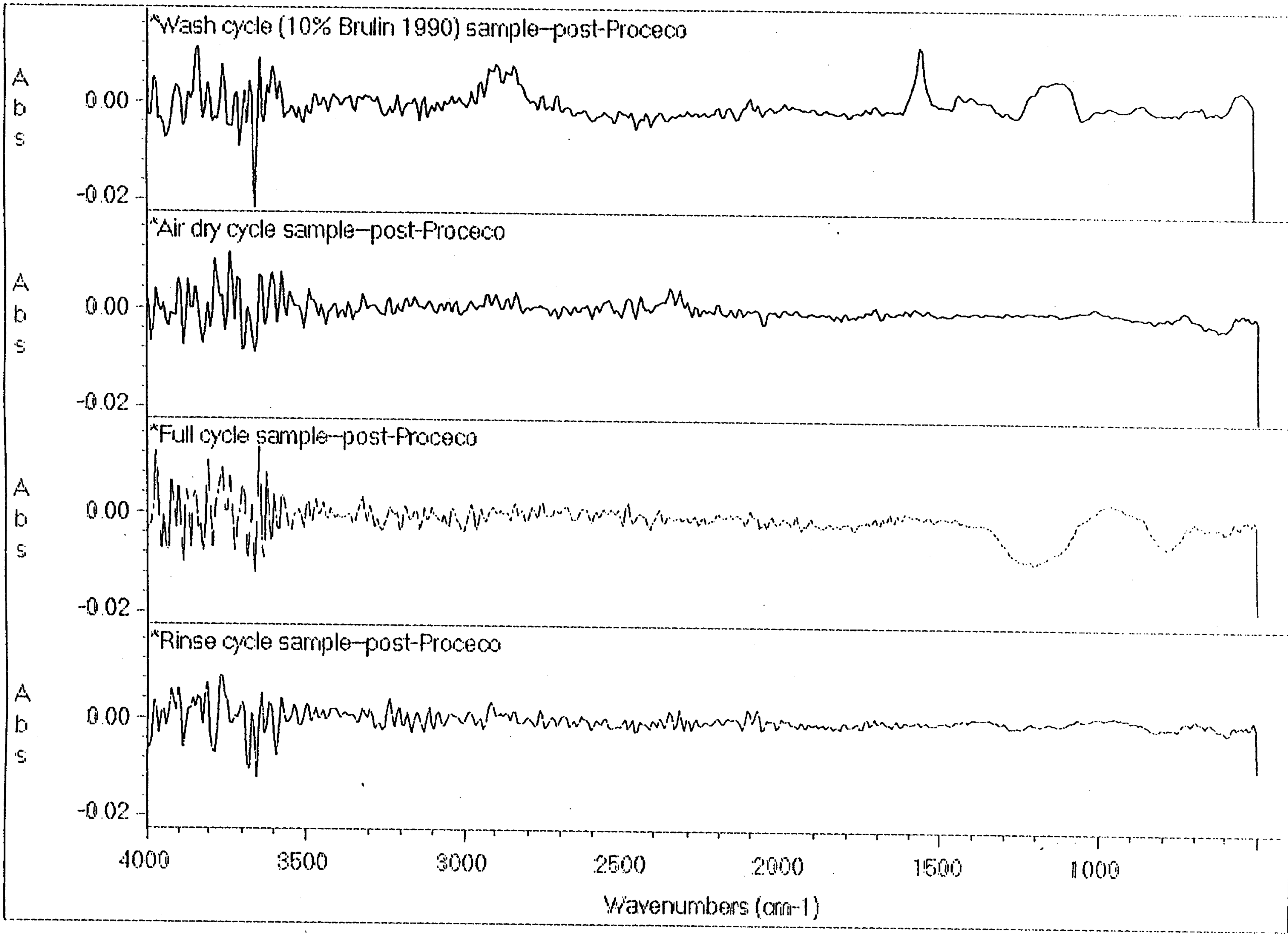
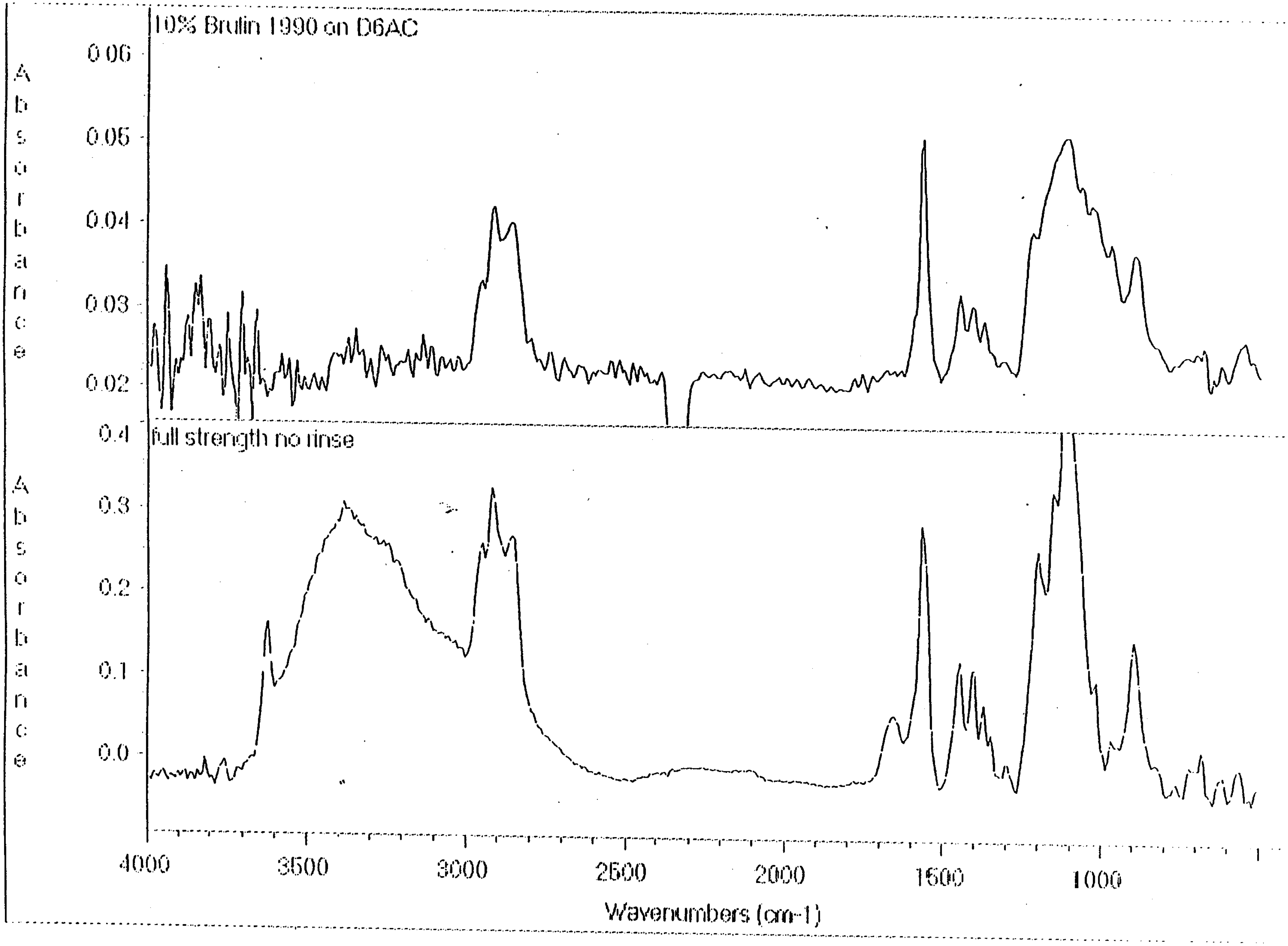

*Wash cycle (10% Brulin 1990) sample--post-Proceco
*Air dry cycle sample--post-Proceco
*Full cycle sample--post-Proceco
*Rinse cycle sample--post-Proceco
A b s
0.00
-0.02
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 46



10% Brulin 1990 on D6AC
0.06
0.05
0.04
0.03
0.02
Absorbance
0.4
full strength no rinse
0.3
0.2
0.1
0.0
Absorbance
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 47

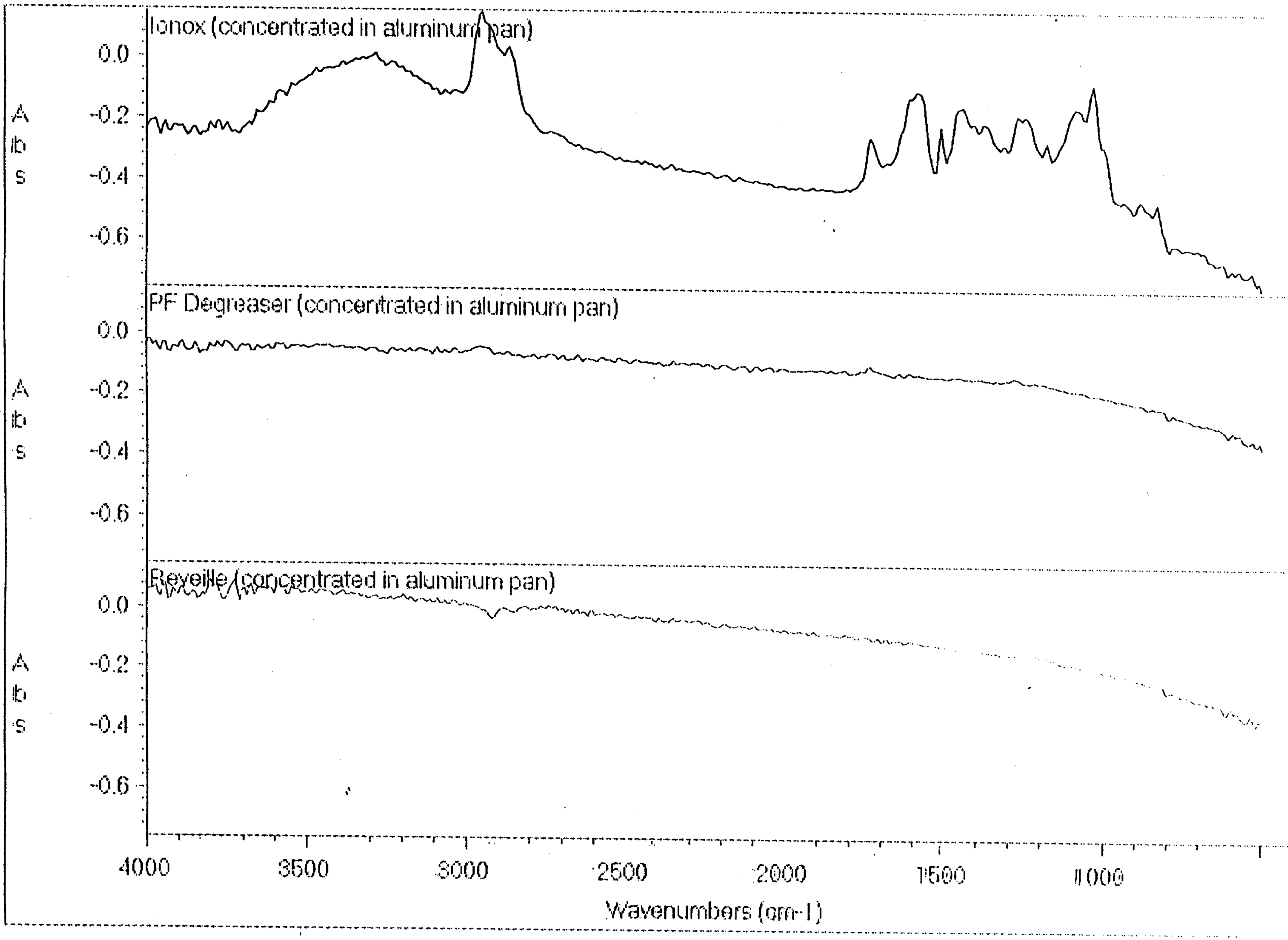
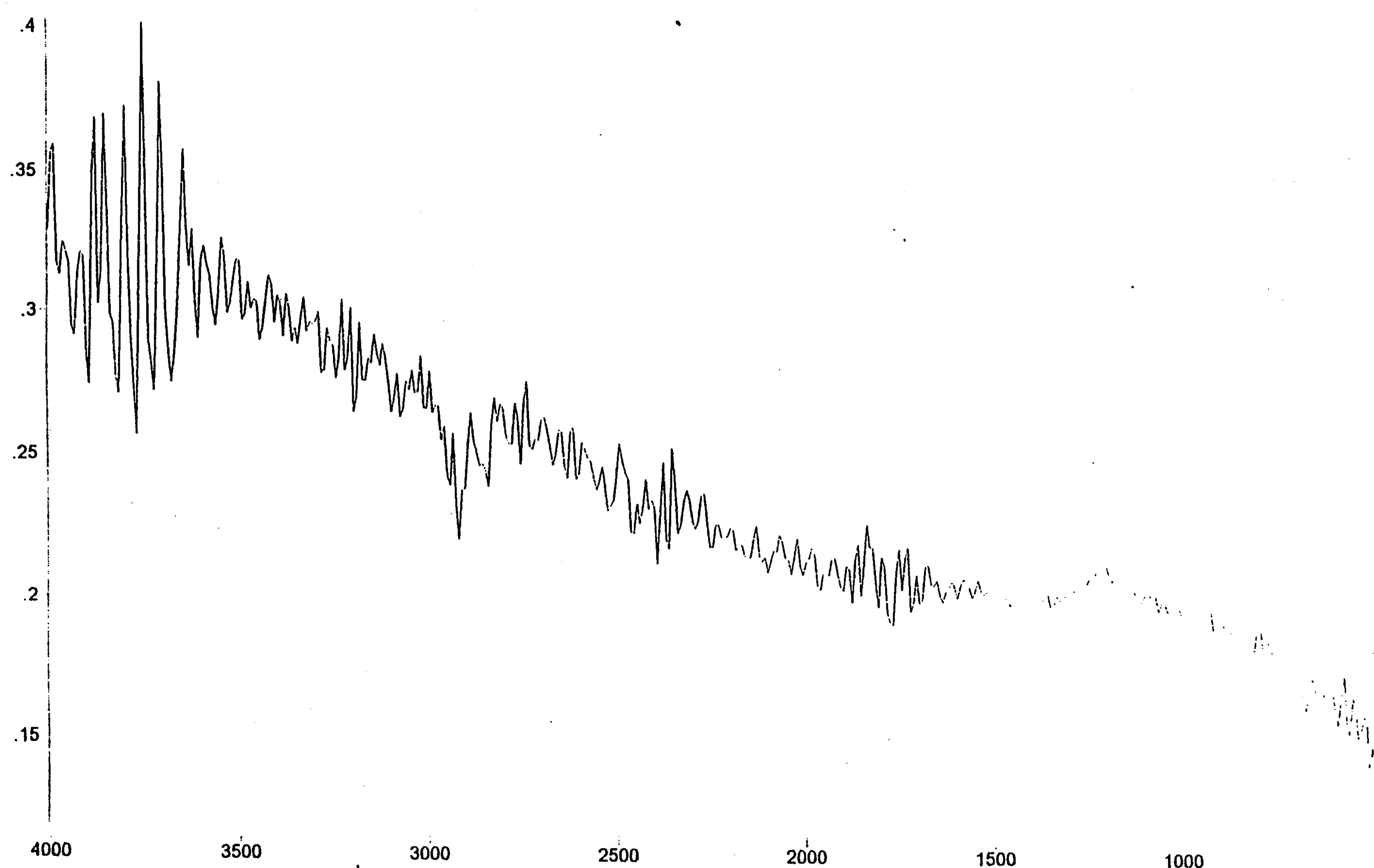

Ionox (concentrated in aluminum pan)
PF Degreaser (concentrated in aluminum pan)
Reveille (concentrated in aluminum pan)
Abs
0.0
-0.2
-0.4
-0.6
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

Figure 48 : SOC-400 Analysis of Reveille



Absorbance / Wavenumber (cm-1)

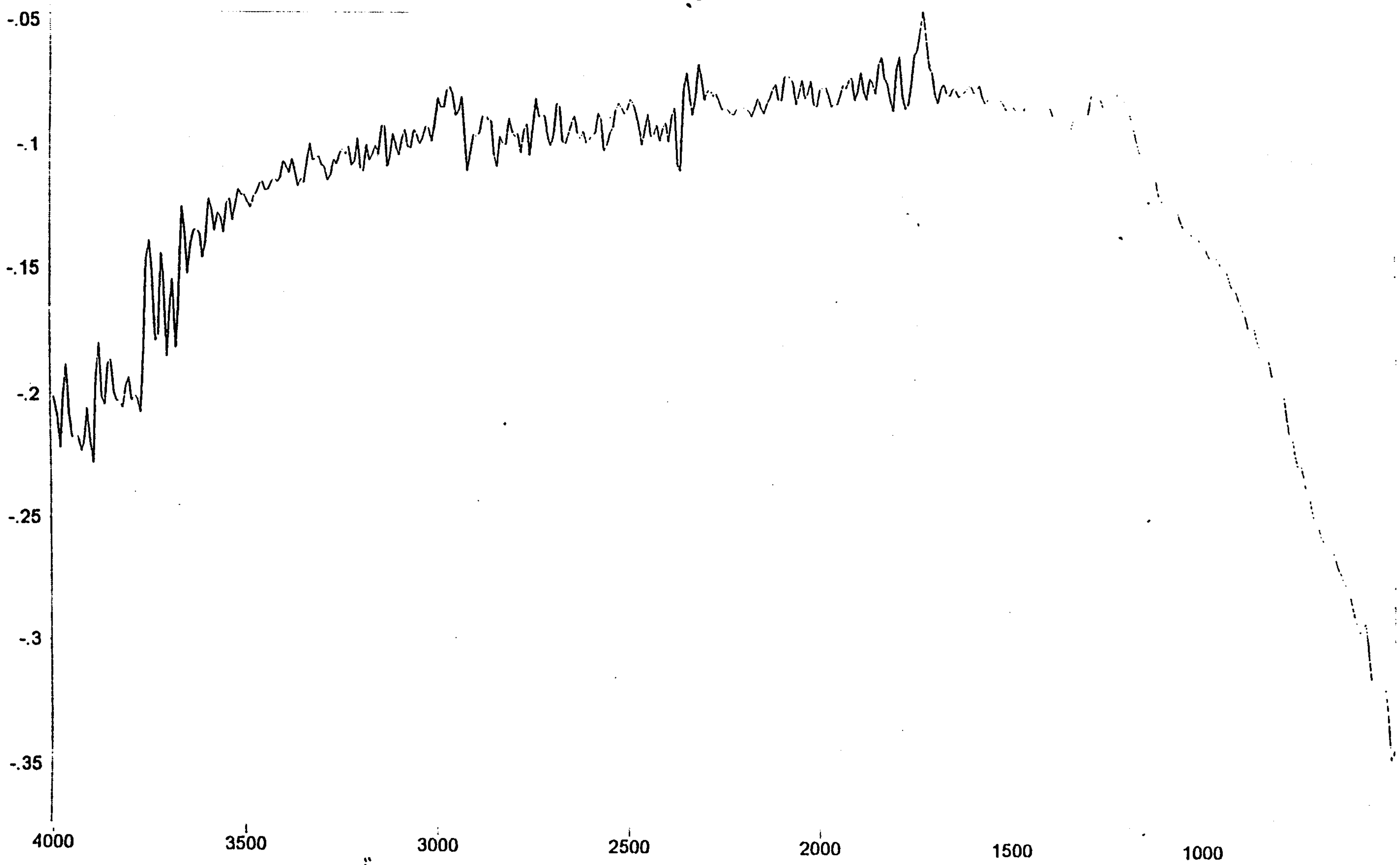
File # 1 = REV1

foil pan--3 concentrations

Paged Y-Zoom CURSOR

11/18/96 4:48 PM Res=16 cm-1

Figure 49 : SOC-400 Analysis of PF Degreaser



Absorbance / Wavenumber (cm-1)

File # 2 = PF1

foil pan--3 concentrations

Paged Y-Zoom CURSOR

11/18/96 4:53 PM Res=16 cm-1

Figure 50 : SOC-400 Analysis of PF Degreaser

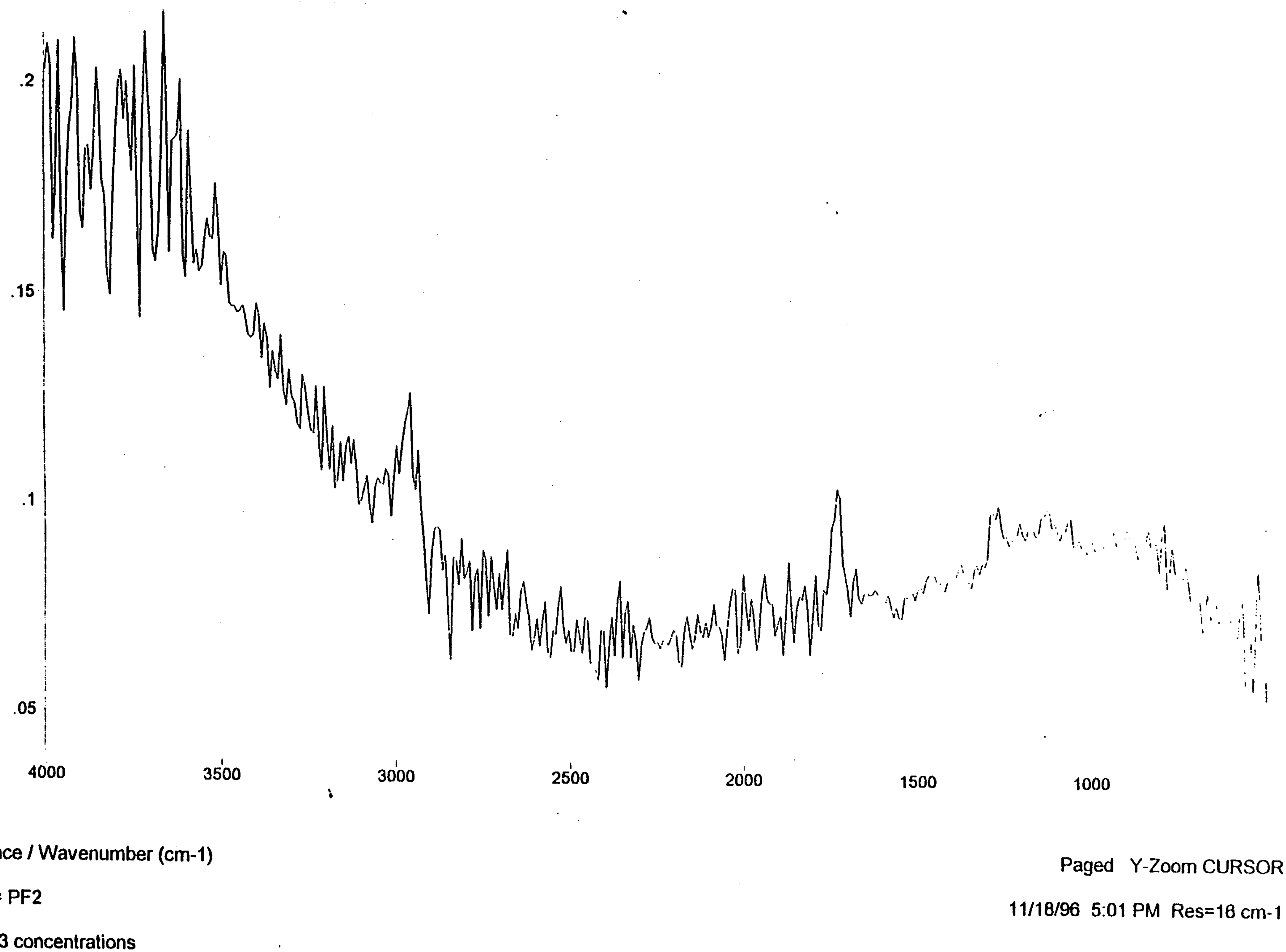


Figure 51 : NIR Analysis of PF Degreaser

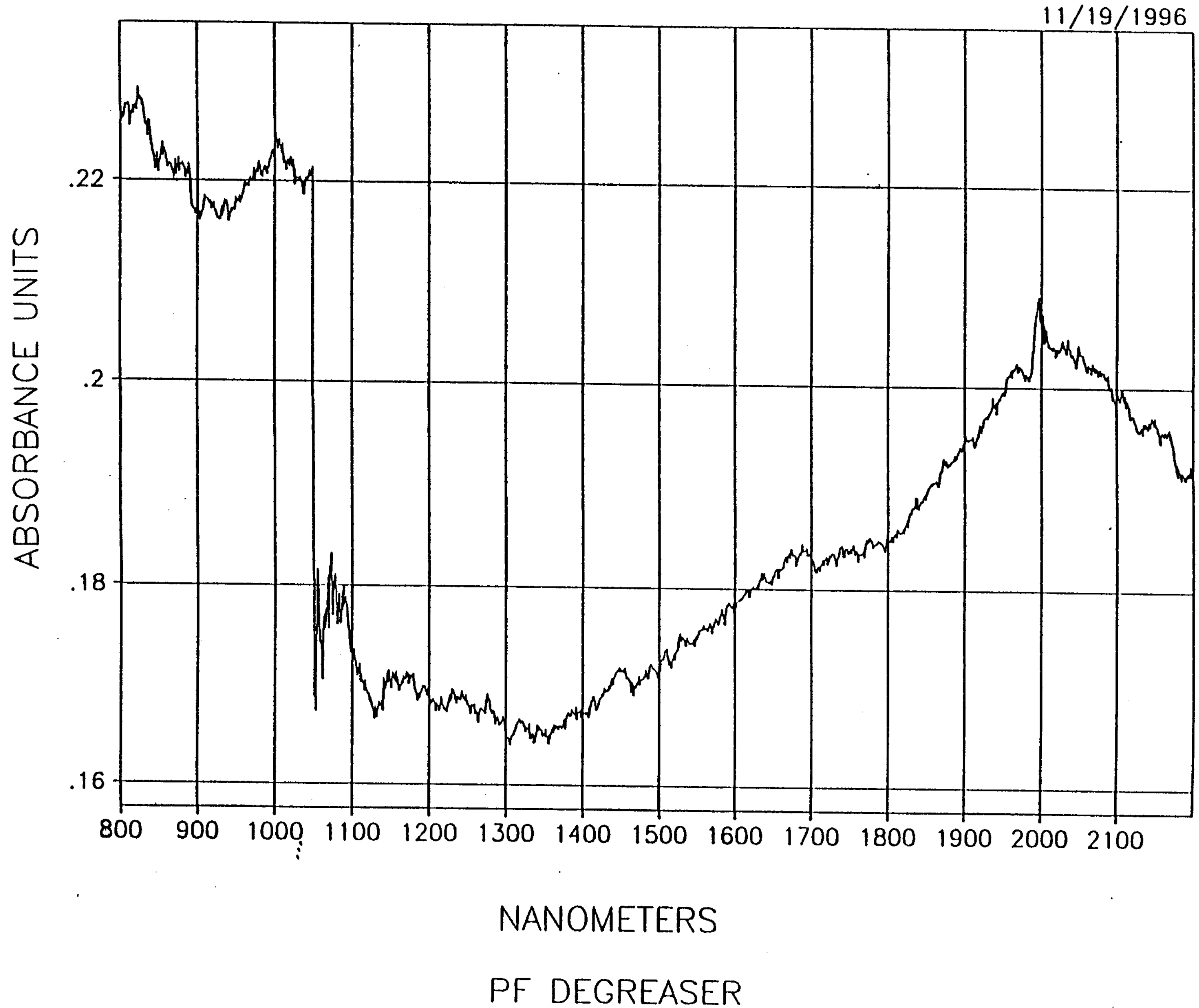
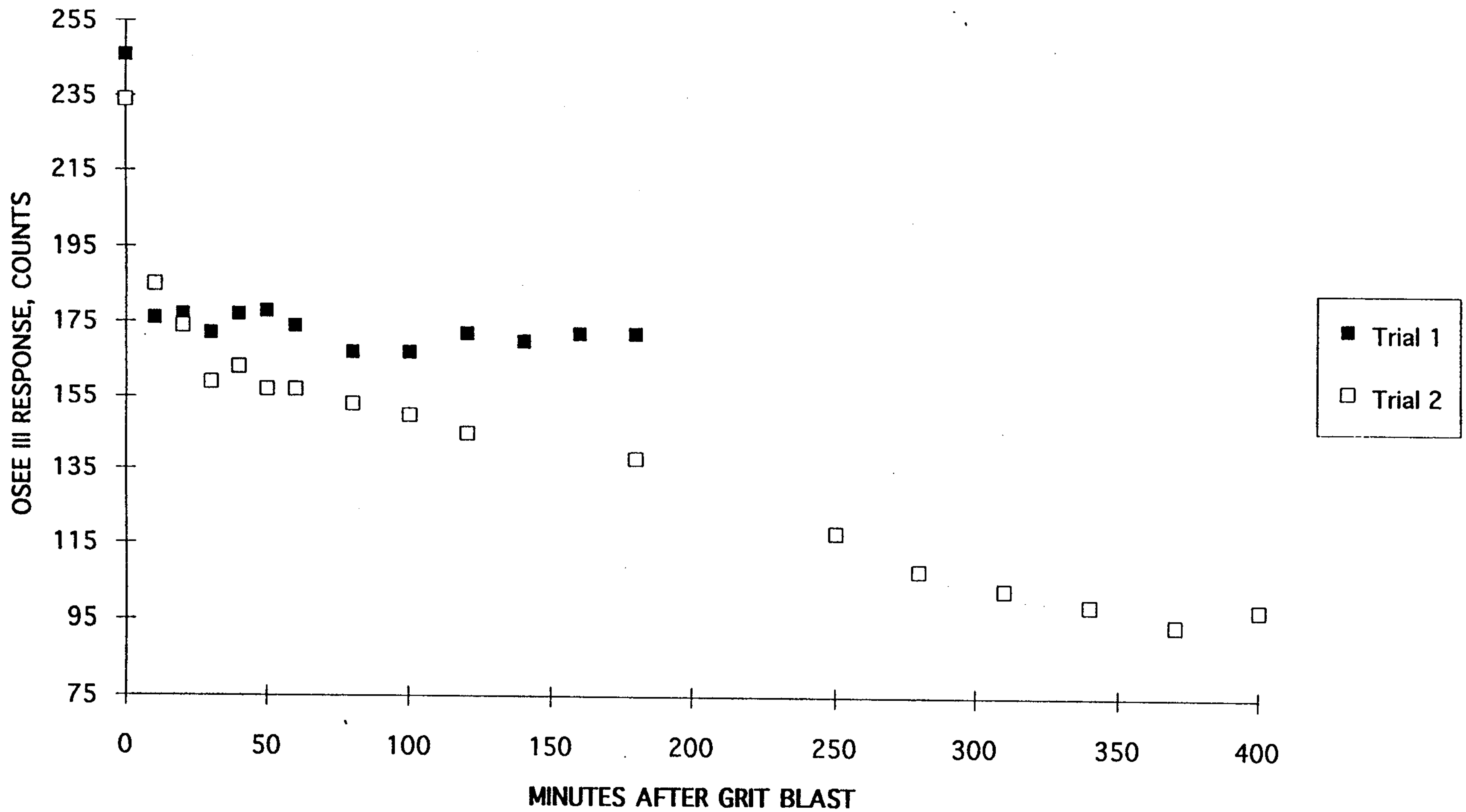
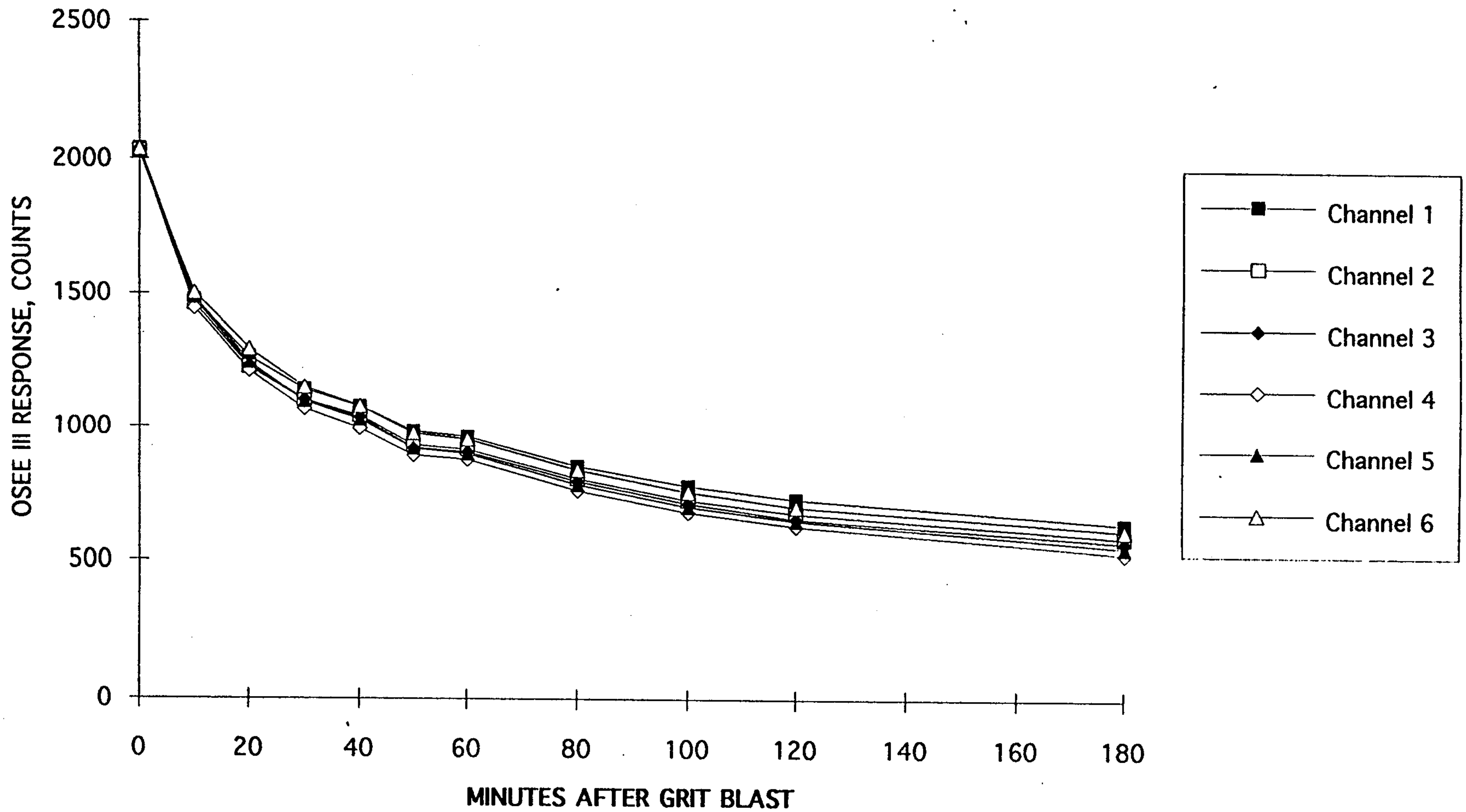


Figure 52: RESULTS FROM ANALYSES OF GRIT BLASTED D6AC STEEL PANELS WITH OSEE III SENSOR #2



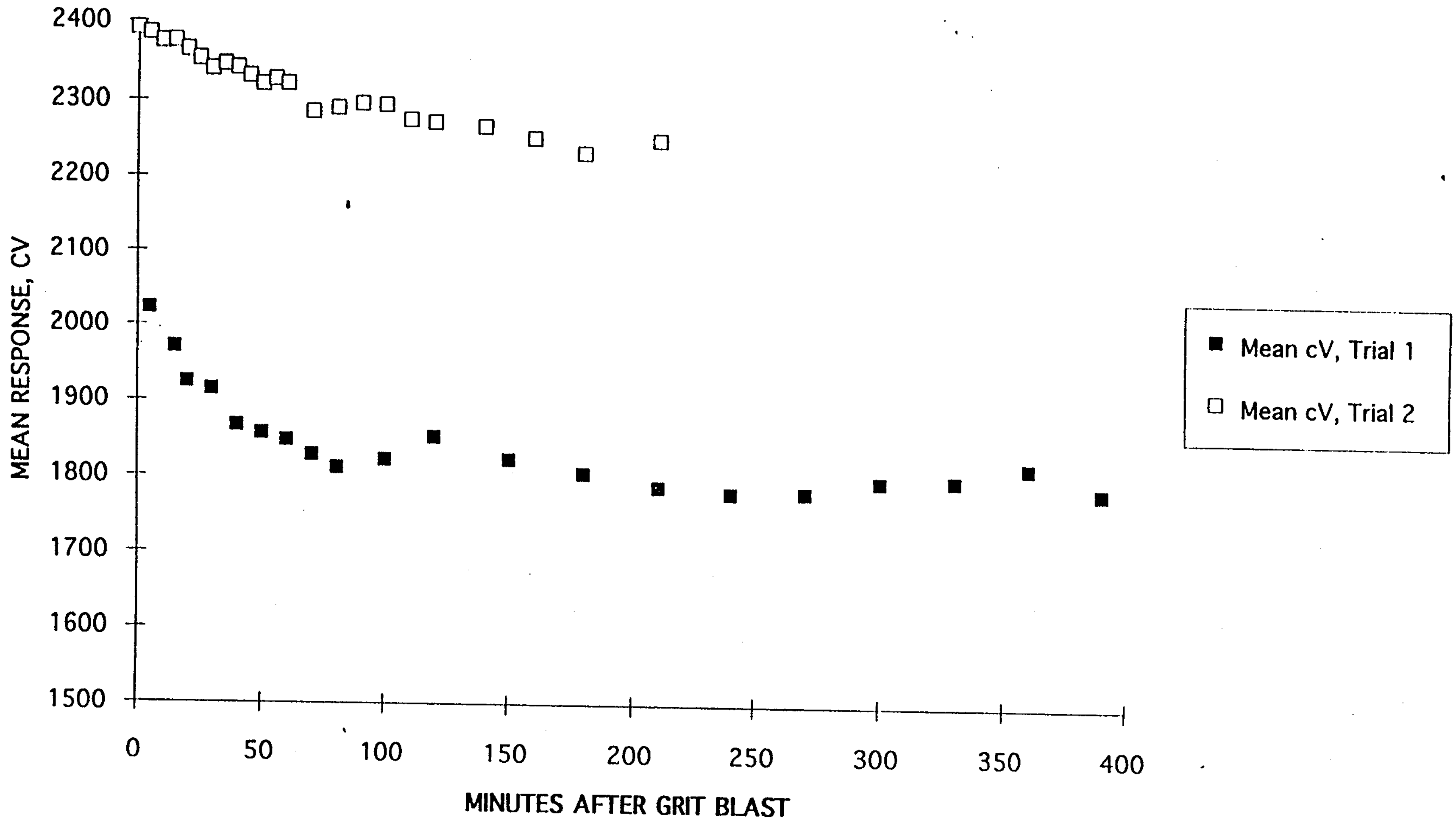
Continuous scanning mode, 1/4" stand-off, scan speed 4. D6AC panels grit blasted at 20 degrees. AC74p/1/96

Figure 53: INITIAL OSEE III ANALYSIS RESULTS WITH GRIT BLASTED 7075-T73 ALUMINUM, SENSOR #2



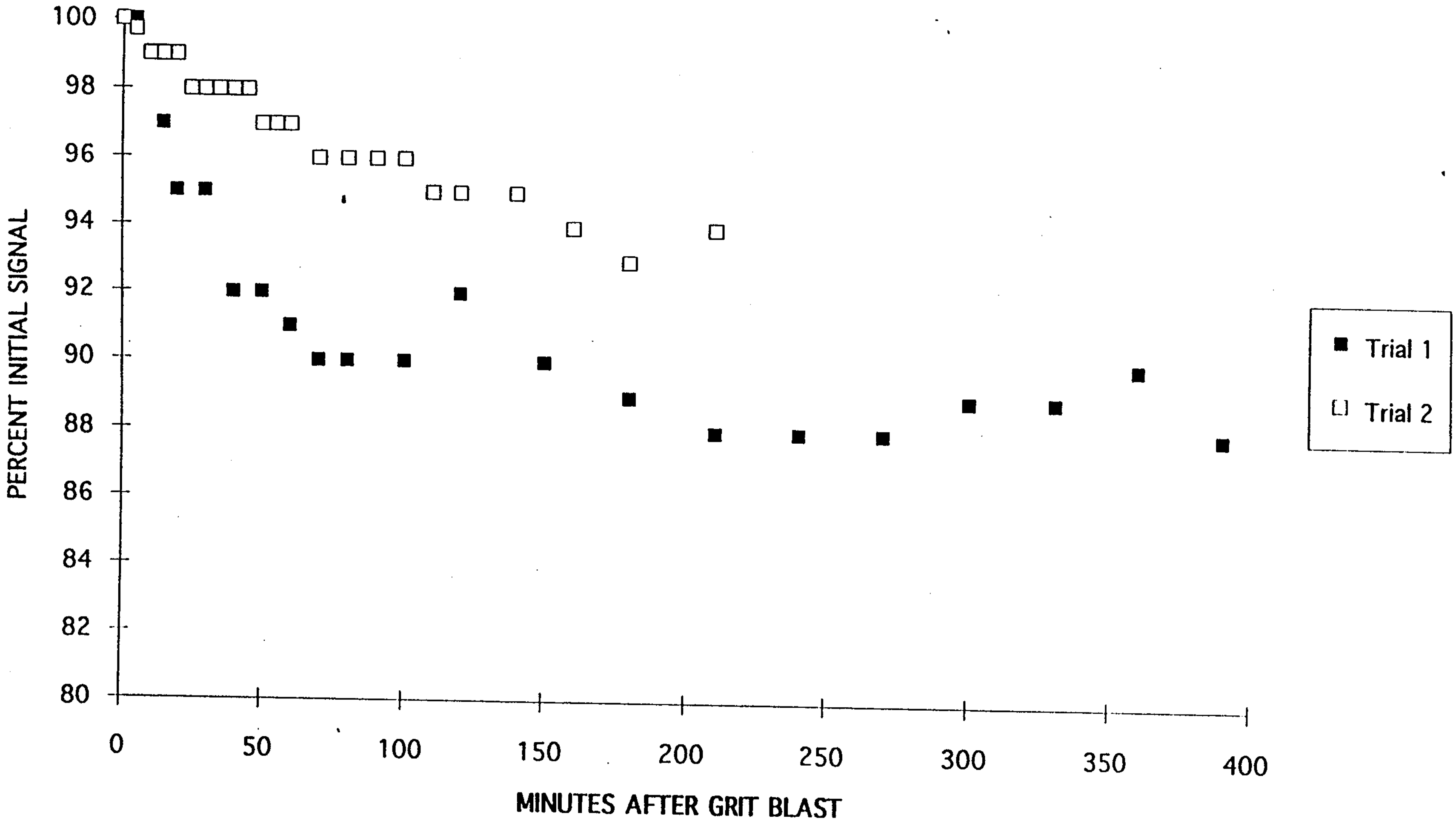
Continuous scanning mode, 1/4" stand-off, scan speed 4. Aluminum panel grit blasted at 20 degrees. AC74q/1/96

Figure 54: RESULTS FROM ANALYSES OF GRIT BLASTED ALUMINUM PANELS WITH OSEE II



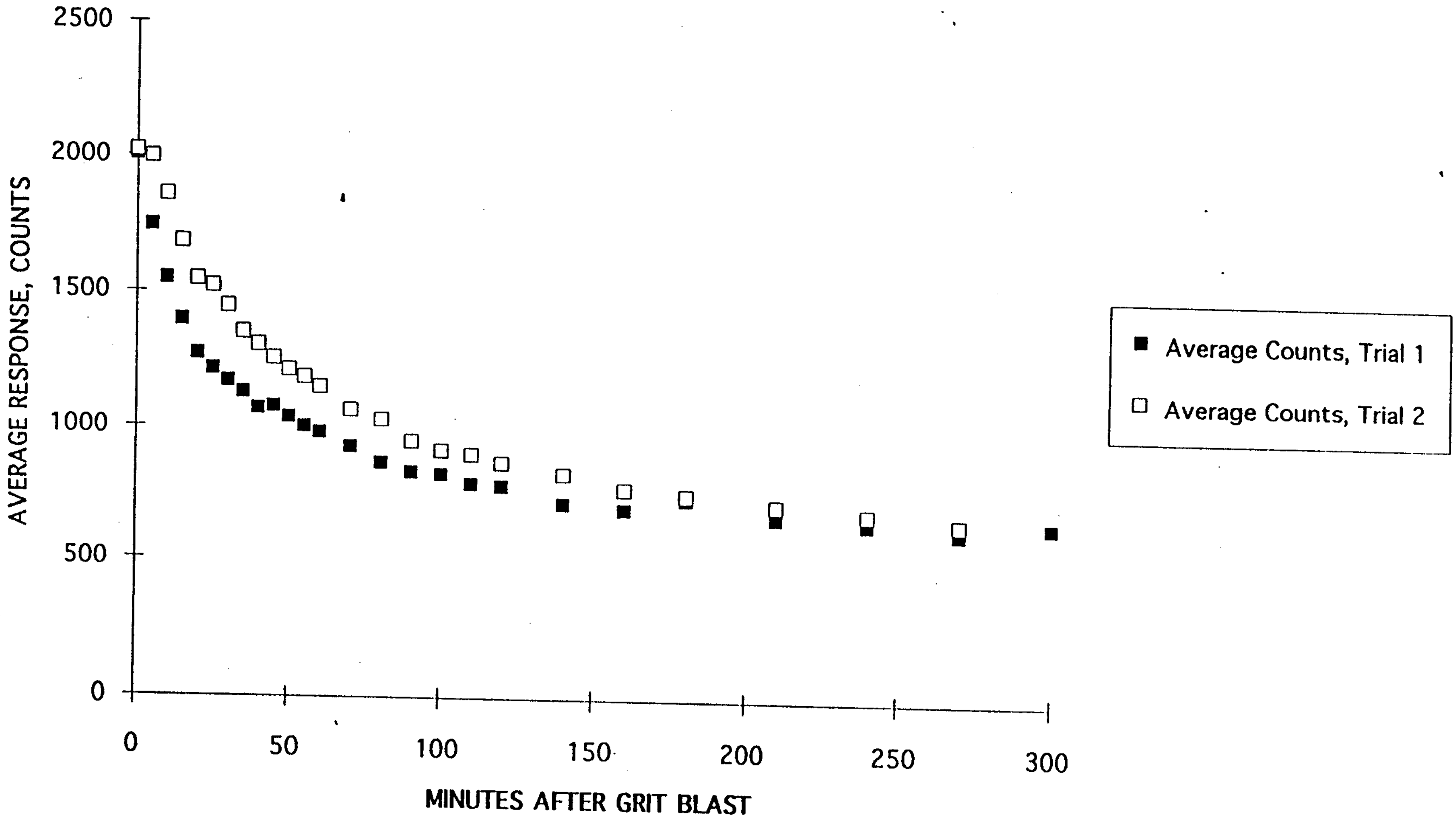
Panels grit blasted at 20 degrees with Zirclean. Stand-off distance set to 1/4" from D6AC steel. Conditions: 75°F/45% RH. AC75I/2/96

Figure 55: PERCENT SIGNAL CHNAGES VERSUS TIME FOR OSEE II ANALYSES OF GRIT BLASTED ALUMINUM PANELS



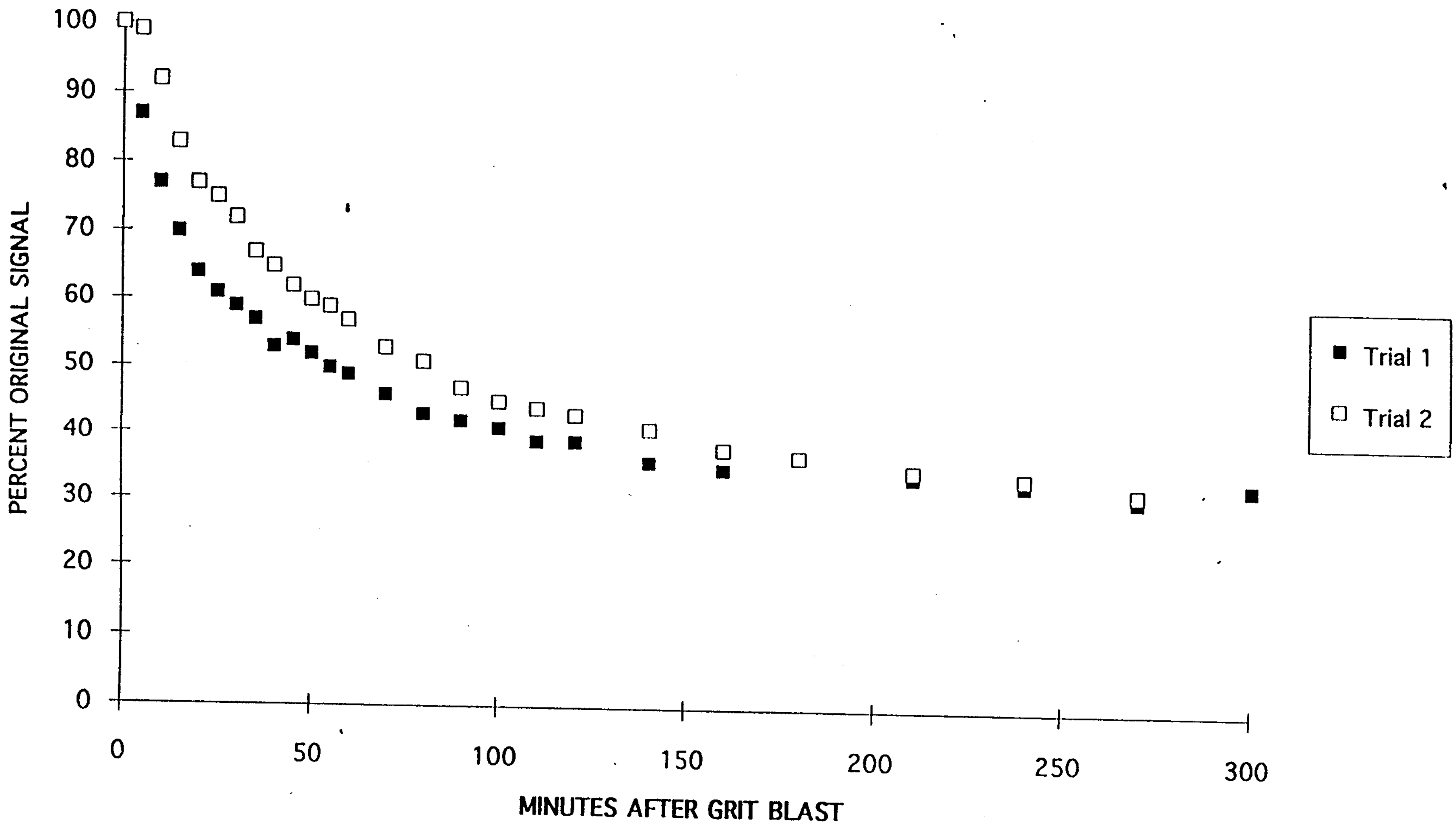
Panels grit blasted at 20 degrees with Zirclean media. Stand-off distance set to 1/4" from D6AC steel. Conditions: 75°F/45% RH.
AC75b/2/96

Figure 56: RESULTS FROM ANALYSES OF GRIT BLASTED ALUMINUM PANELS WITH OSEE III



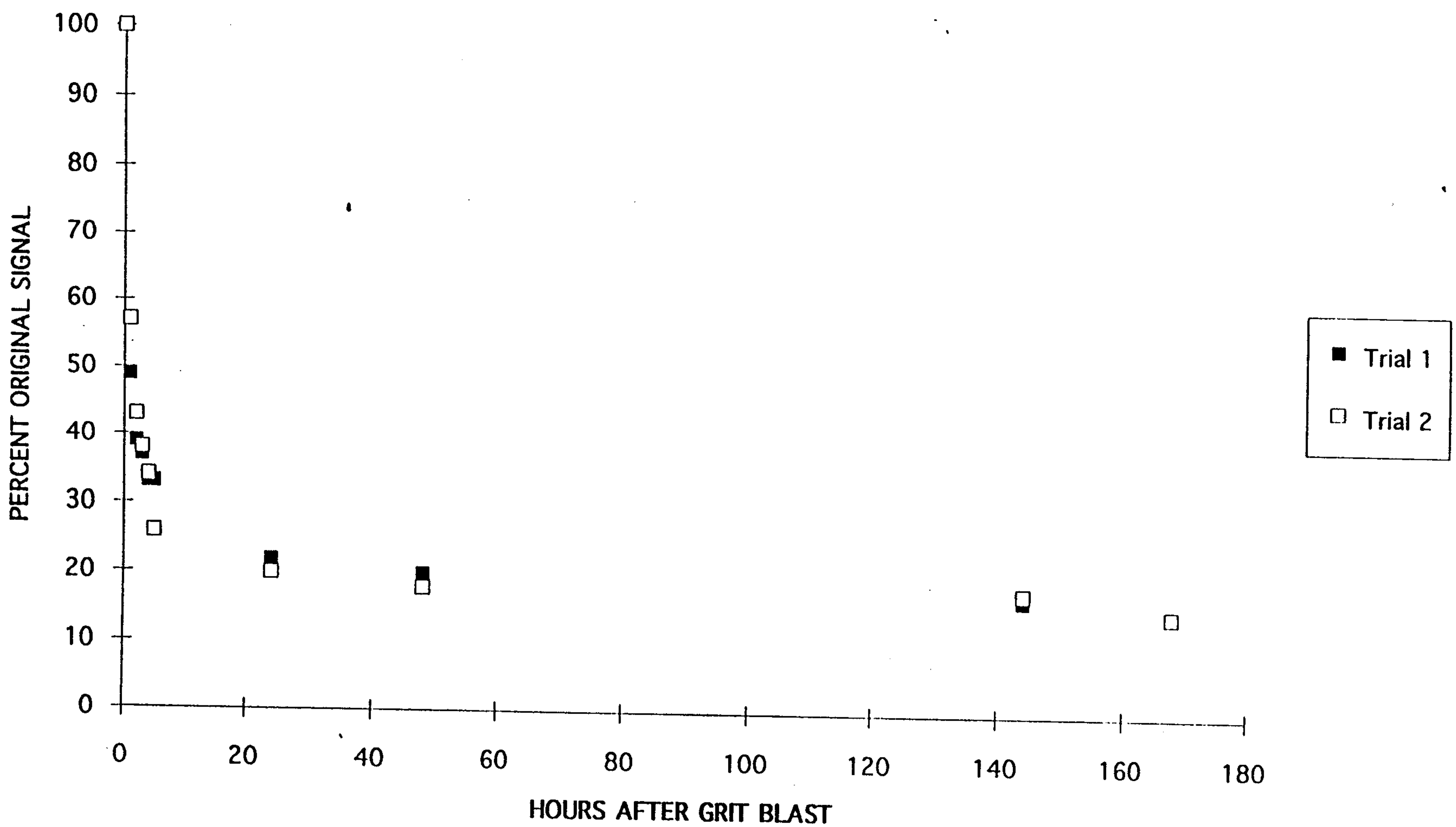
Scan parameters: 1/4" stand-off, continuous scanning mode, scan speed 4, 6" sensor #2. Grit blast angle 20 degrees.
Conditions: 75°F/45% RH. AC75m/2/96

Figure 57: PERCENT SIGNAL CHANGES VERSUS TIME FOR OSEE III ANALYSES OF GRIT BLASTED 7075-T73 ALUMINUM PANELS



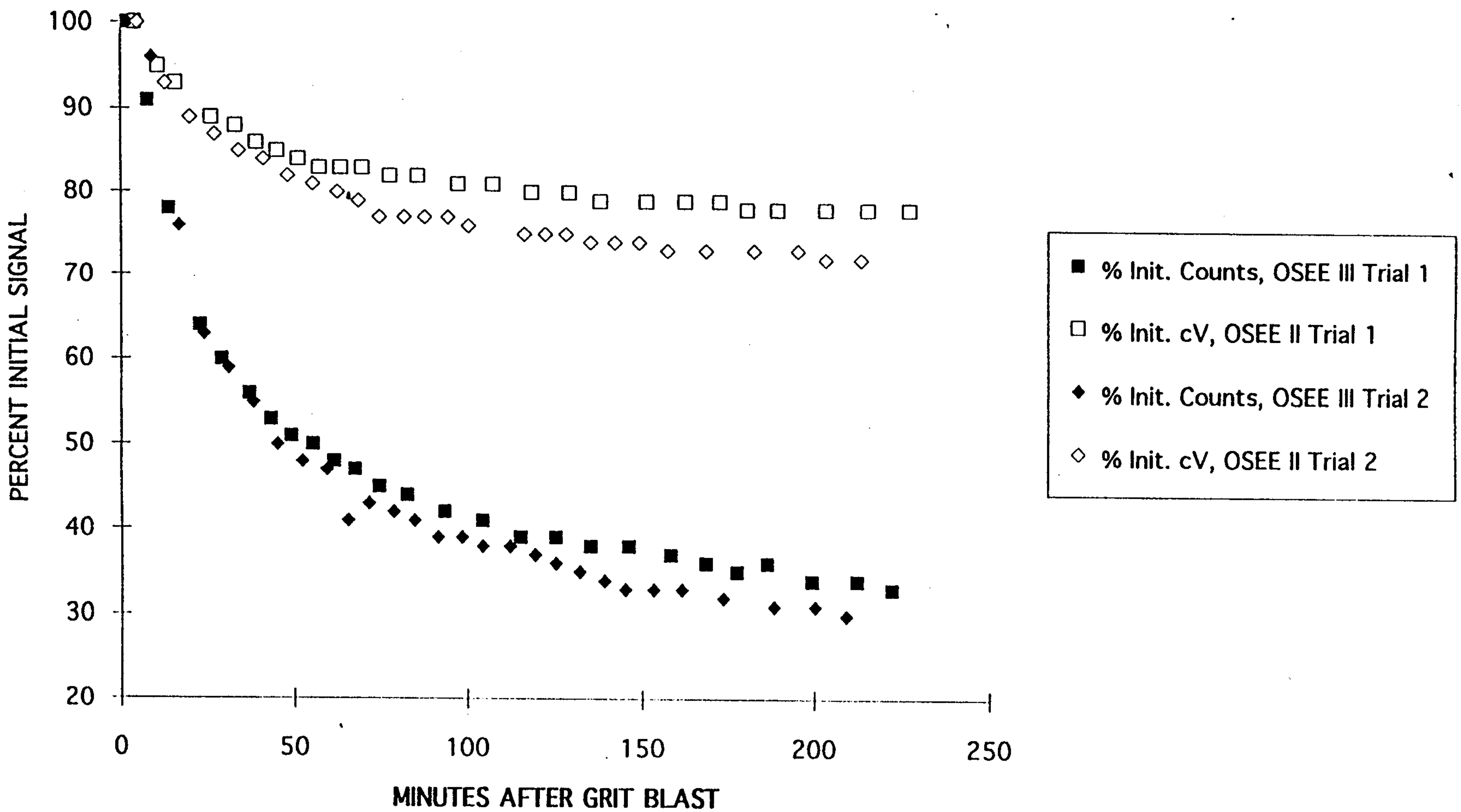
Scan parameters: 1/4" stand-off, continuous scanning mode, scan speed 4, 6" sensor #2. Grit blast angle 20 degrees.
Conditions: 75°F/45% RH. AC75d/2/96

Figure 58: OSEE III RESPONSES VERSUS TIME FOR GRIT BLASTED 7075-T73 ALUMINUM



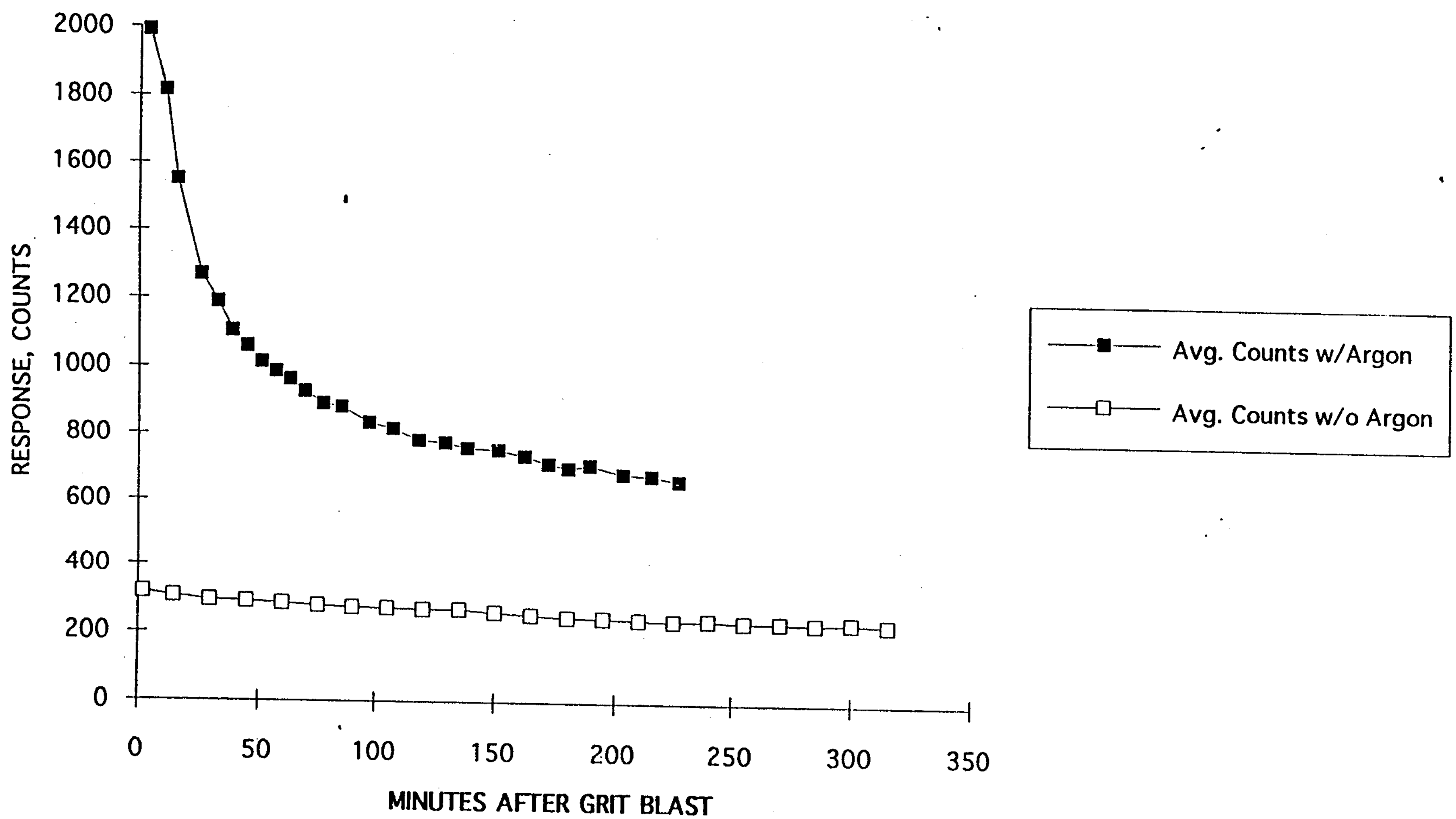
Scan parameters: continuous scanning mode, 1/4" stand-off, scan speed 4, 6" sensor #2. Grit blast angle 20 degrees.
Conditions: 75°F/45% RH. AC75e/2/96

Figure 59: COMPARISON OF OSEE II AND OSEE III PERCENT SIGNAL CHANGES VERSUS TIME FOR GRIT BLASTED 7075-T73 ALUMINUM PANELS



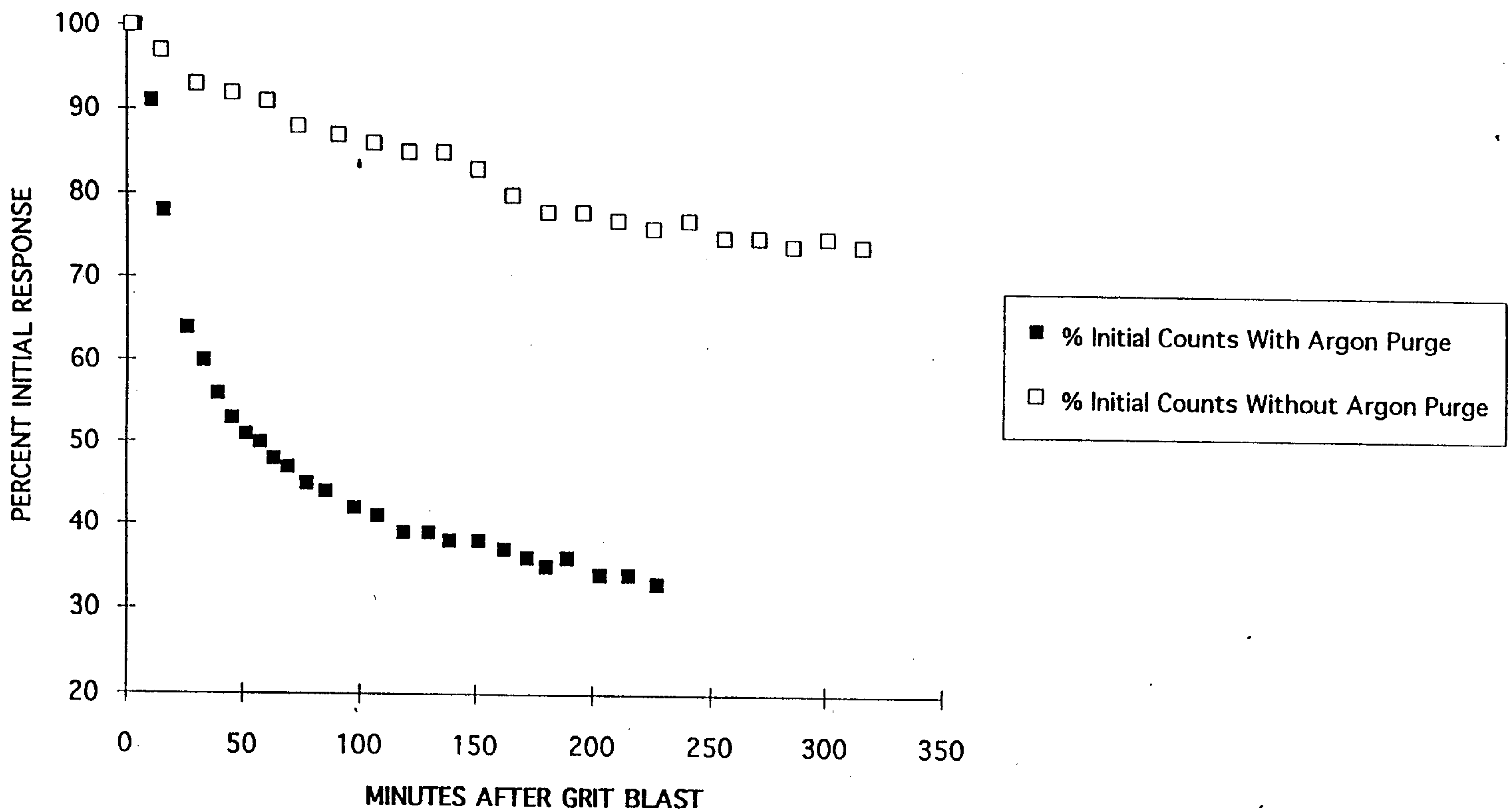
Single aluminum panel shuttled between both instruments. Grit blast angle 20 degrees, stand-off distance 1/4". OSEE III configuration: sensor #2, continuous scanning mode, scan speed 4. Conditions: 75°F/45% RH. AC75g/2/96

Figure 60: OSEE III RESPONSES TO GRIT BLASTED ALUMINUM, WITH OR WITHOUT ARGON PURGING OF THE SENSOR/SUBSTRATE GAP REGION



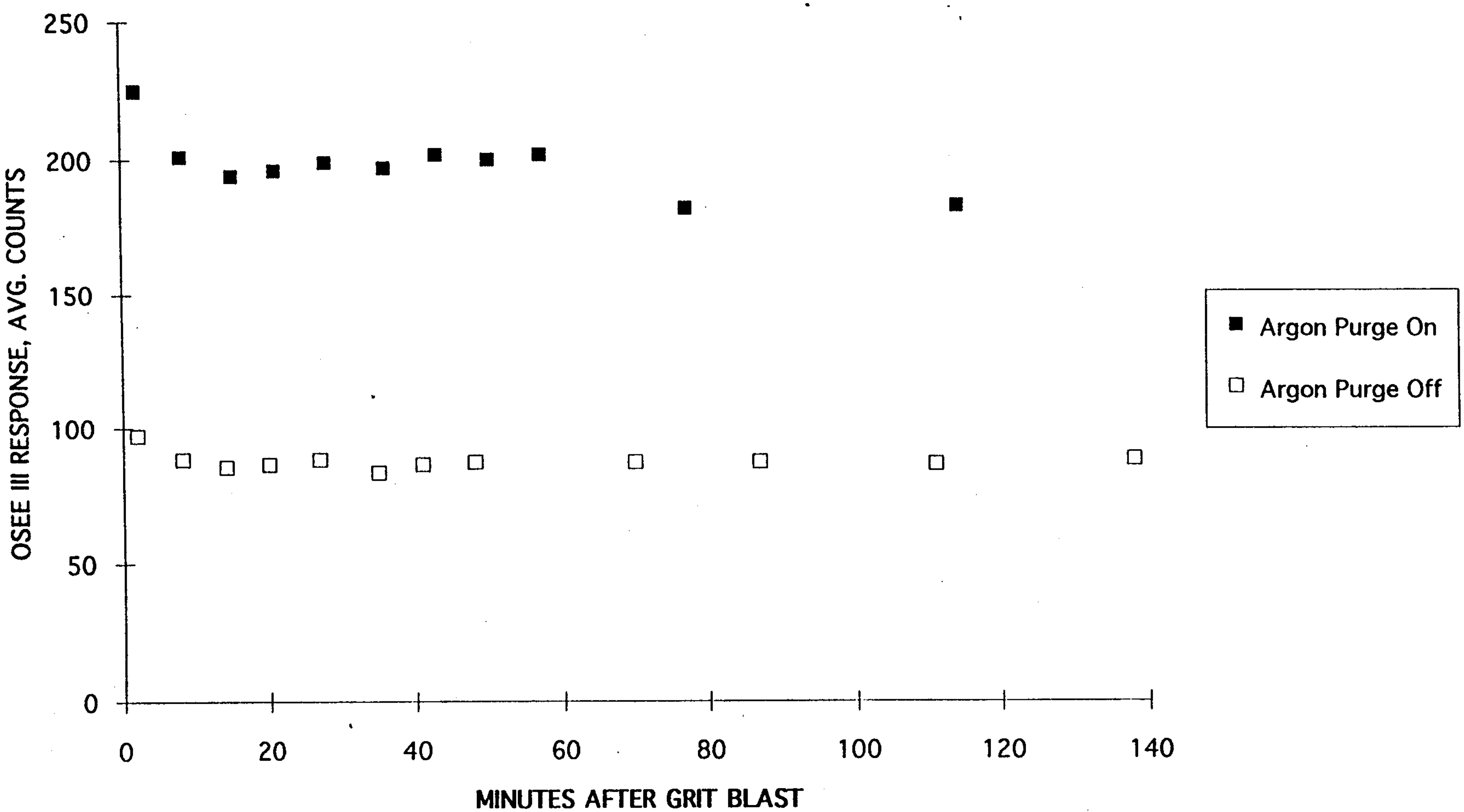
Continuous scanning of freshly grit-blasted 7075-T73 aluminum. Scan speed 4, stand-off 1/4", 6" sensor #2. Grit blast angle 20 degrees. Conditions: 75°F/45% RH. AC75h/2/96

Figure 61: COMPARISON OF PERCENT OSEE III RESPONSE CHANGES TO 7075-T73 ALUMINUM-WITH AND WITHOUT ARGON PURGING TO THE SENSOR/SUBSTRATE GAP REGION



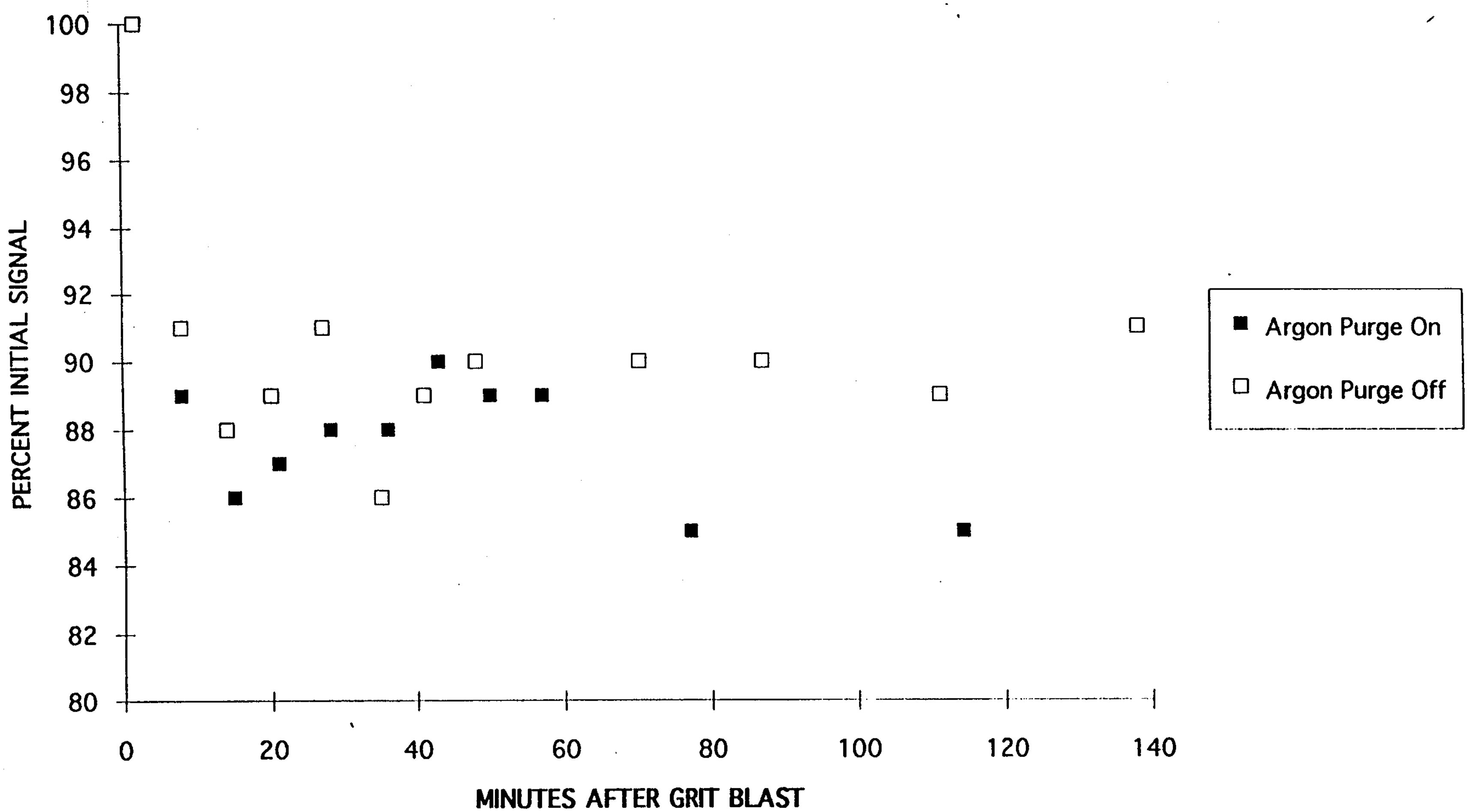
Aluminum panel grit blasted at 20 degrees with Zirclean. Stand-off distance 1/4", scan speed 4, continuous scanning mode, 6" sensor #2. Conditions: 75°F/45% RH. AC75j/2/96

Figure 62: OSEE III RESPONSES TO D6AC STEEL WHEN THE SENSOR/SUBSTRATE GAP REGION WAS NOT PURGED WITH ARGON GAS



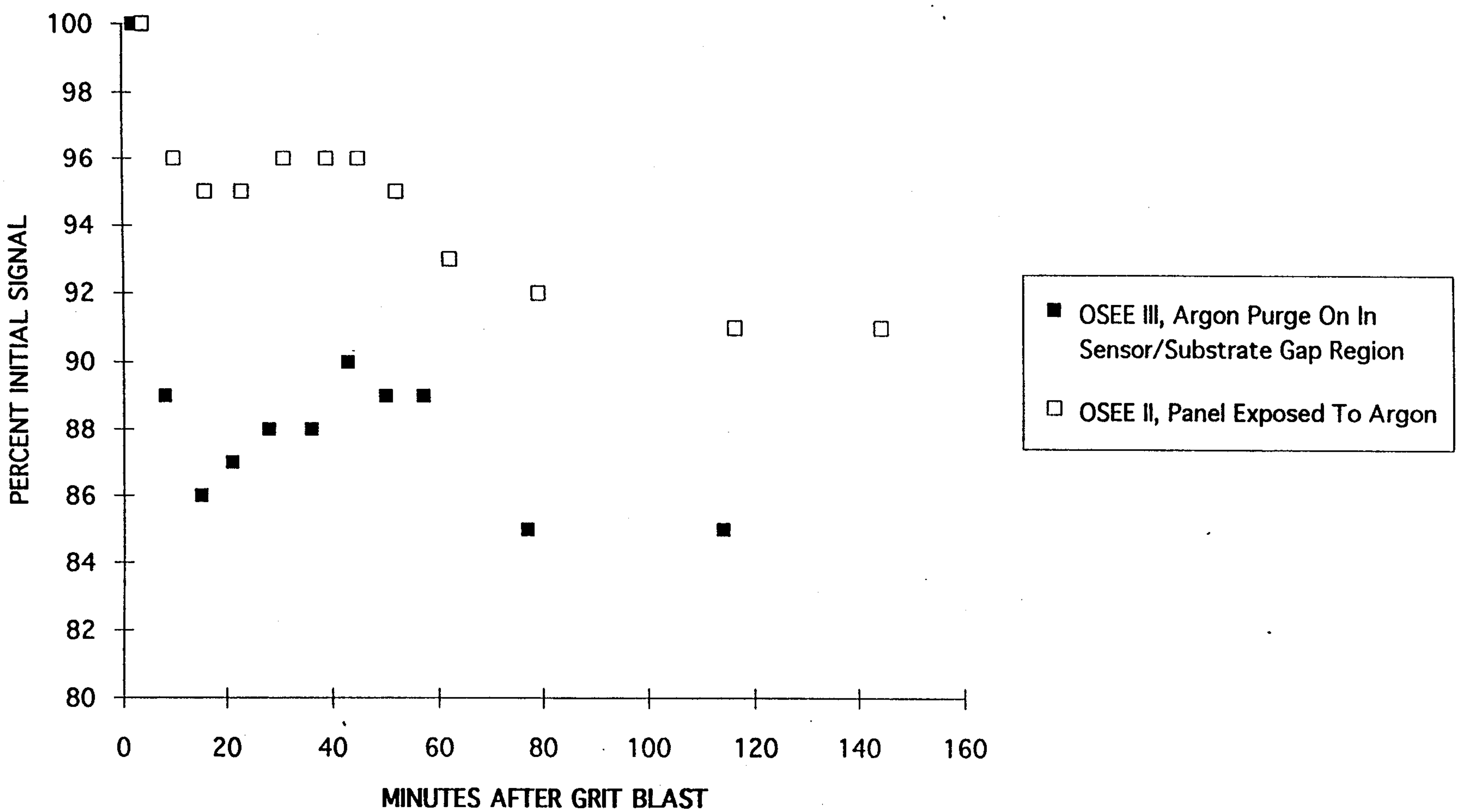
Continuous scanning mode, 1/4" stand-off, scan speed 4, 6" sensor #2. Grit blast angle 20 degrees. One panel was scanned with the argon purge turned on, and a second panel was scanned with the argon purge turned off. Temp.=75F, RH=15%. AC76q/3/96

Figure 63 : PERCENT OSEE III SIGNAL CHANGES FOR D6AC STEEL WHEN THE SENSOR/SUBSTRATE GAP REGION WAS NOT PURGED WITH ARGON GAS



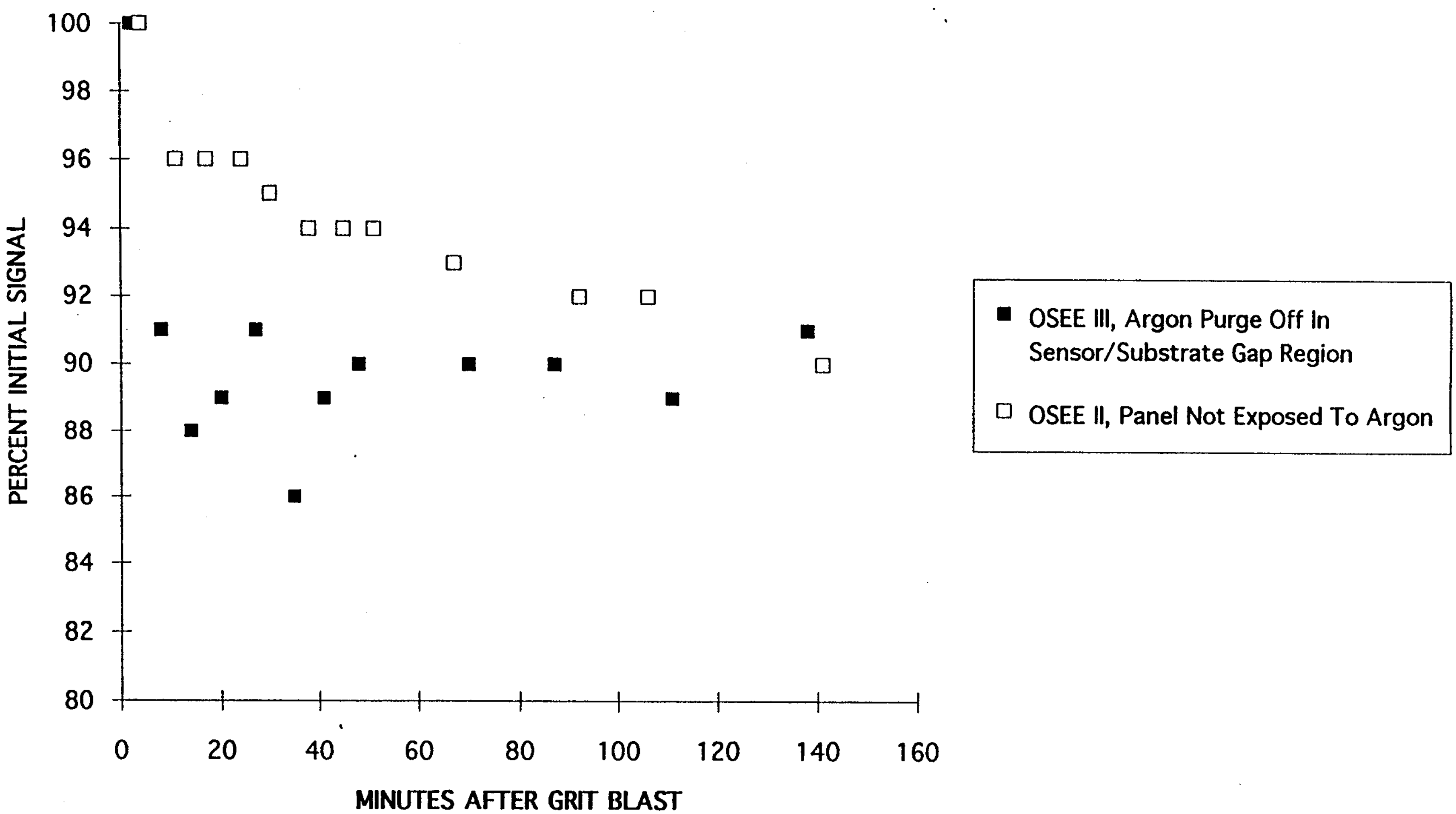
Continuous scanning mode, 1/4" stand-off, scan speed 4, 6" sensor #2. Grit blast angle 20 degrees. One panel was scanned with the argon purge turned on, and a second panel was scanned with the argon purge turned off. Temp.=75F, RH=15%. AC76s/3/96

Figure 64 : COMPARISON OF OSEE II AND OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL



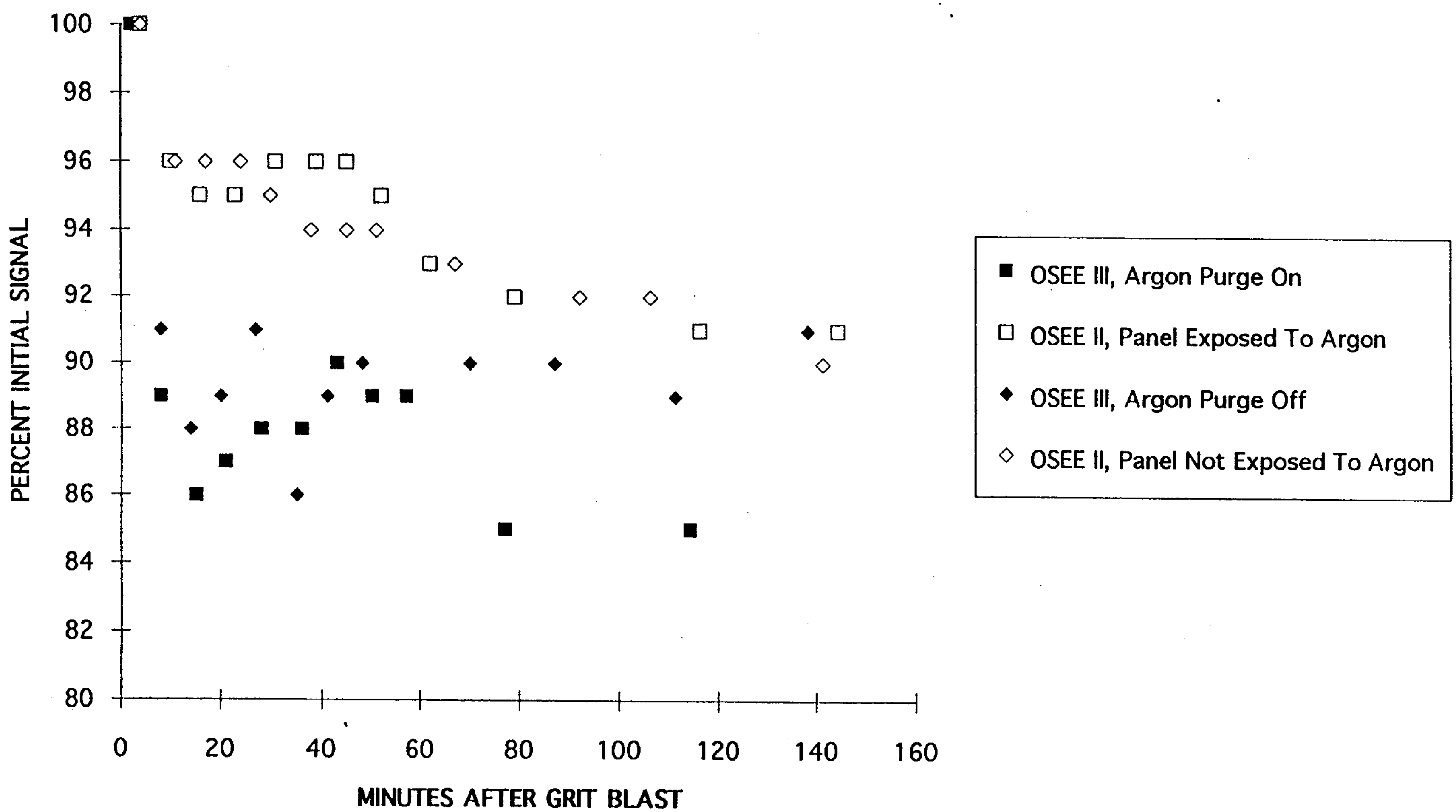
1/4" stand-off, grit blast angle 20 degrees. OSEE III: speed 4, sensor #2, continuous mode. Single D6AC panel was shuttled between the two instruments. Temp.=75F, RH=15%. AC76V/3/96

Figure 65: COMPARISON OF OSEE II AND OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL



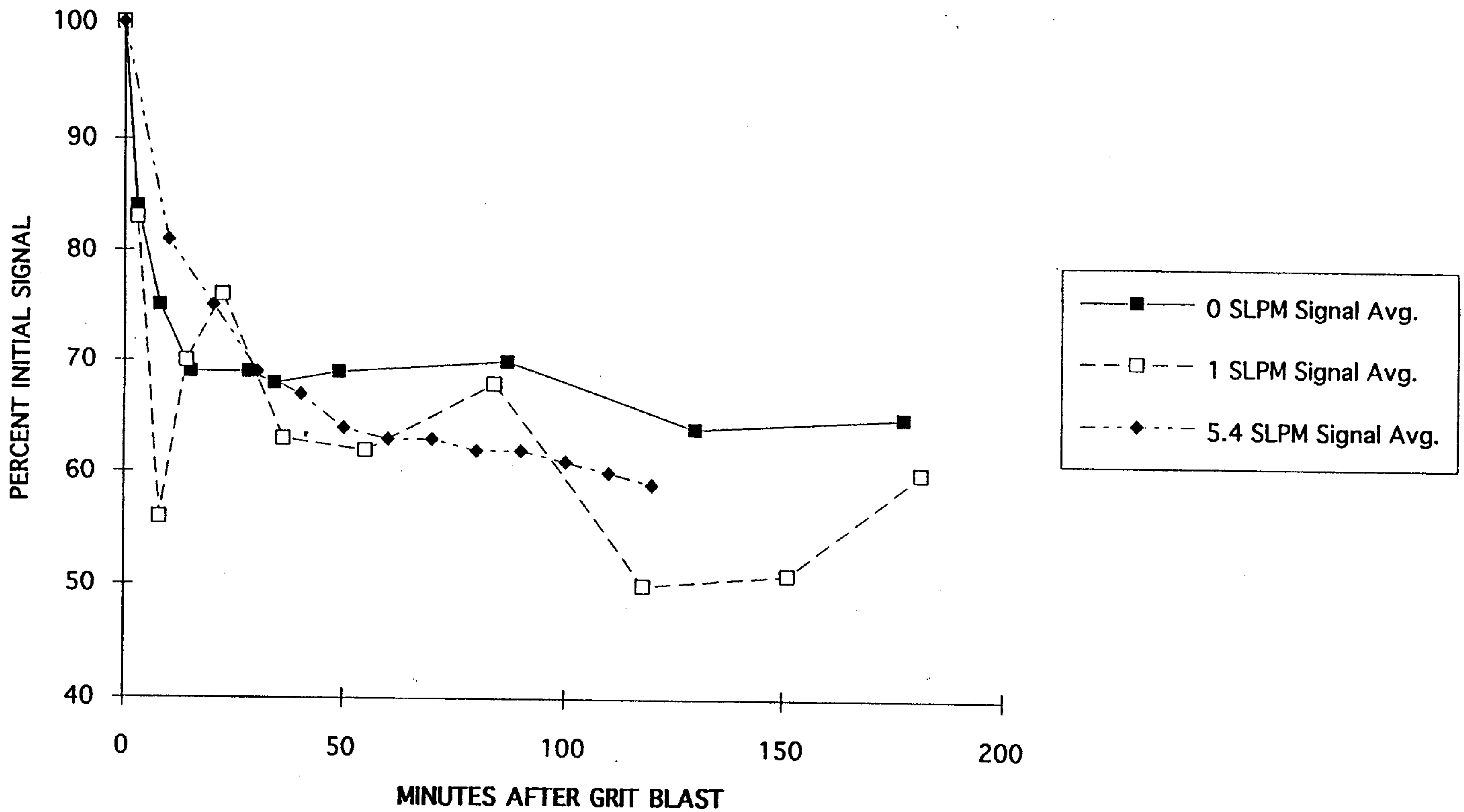
1/4" stand-off, grit blast angle 20 degrees. OSEE III: speed 4, sensor #2, continuous mode. Single D6AC panel was shuttled between the two instruments. Temp.=75F, RH=15%. AC76W/3/96

Figure 66: COMPARISON OF OSEE II AND OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL



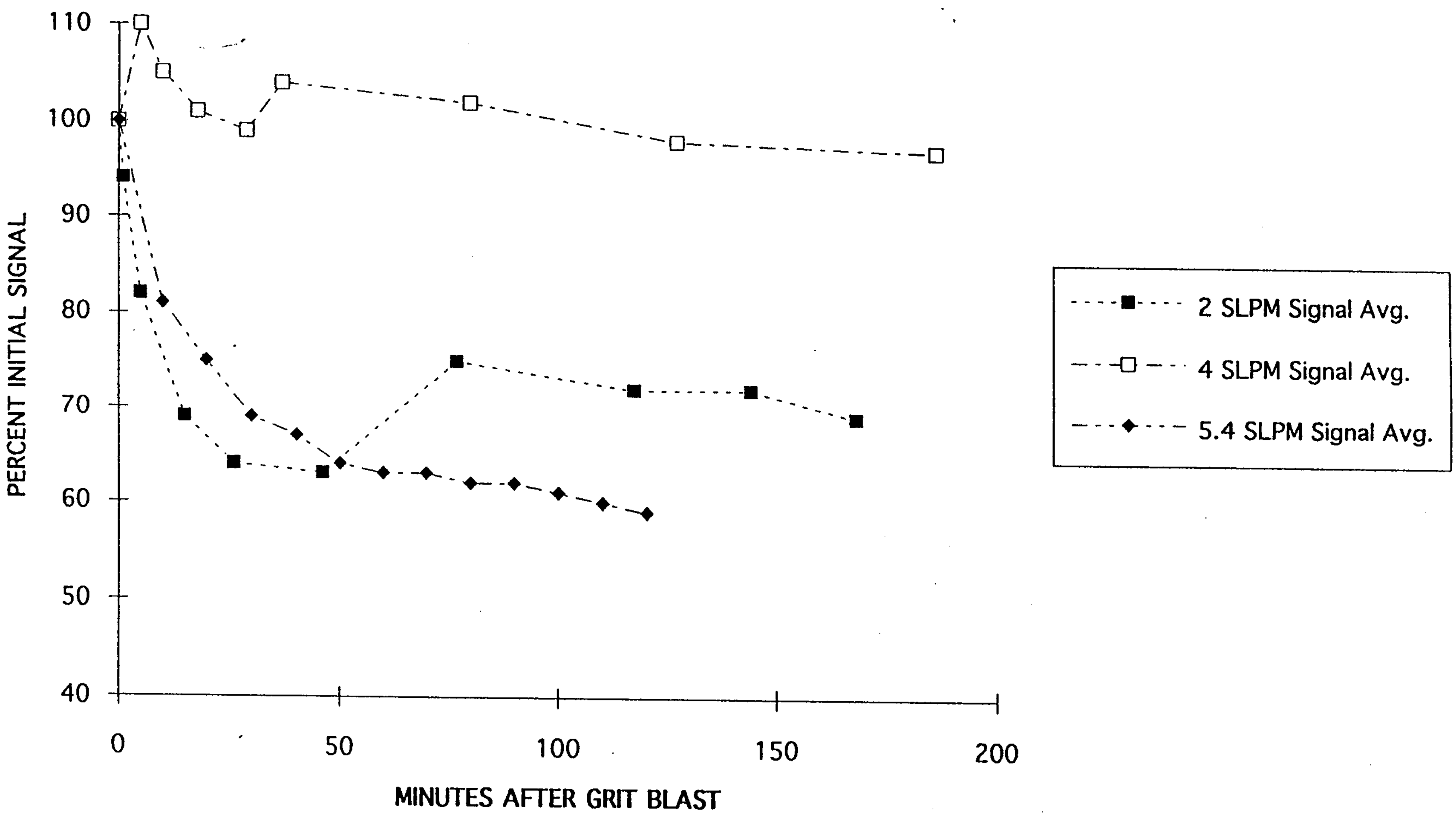
1/4" stand-off, grit blast angle 20 degrees. OSEE III: speed 4, sensor #2, continuous mode. Panels shuttled between the two instruments. Temp.=75F, RH=15%. AC76U/3/96

Figure 67 : EFFECT OF ARGON PURGE RATE ON OSEE III PERCENT SIGNAL CHANGES OVER TIME FOR D6AC STEEL



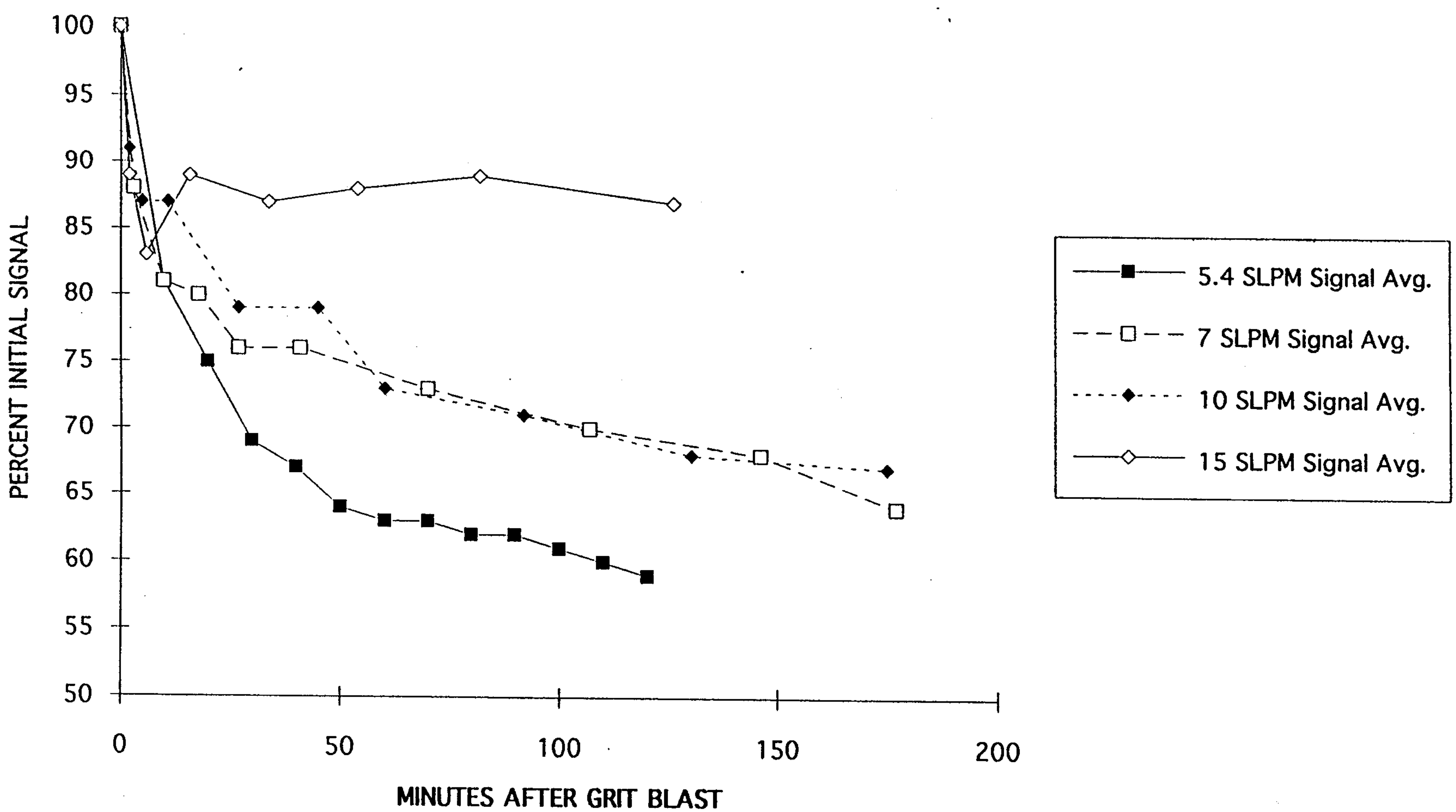
Scan parameters: 1/4" stand-off, speed 1 cm/sec., continuous mode. Typical environmental conditions were 74-76F and 20-30% RH. Grit blast angle 20 degrees. AC80f/6/96

Figure 68: EFFECT OF ARGON PURGE RATE ON OSEE III PERCENT SIGNAL CHANGES OVER TIME FOR D6AC STEEL



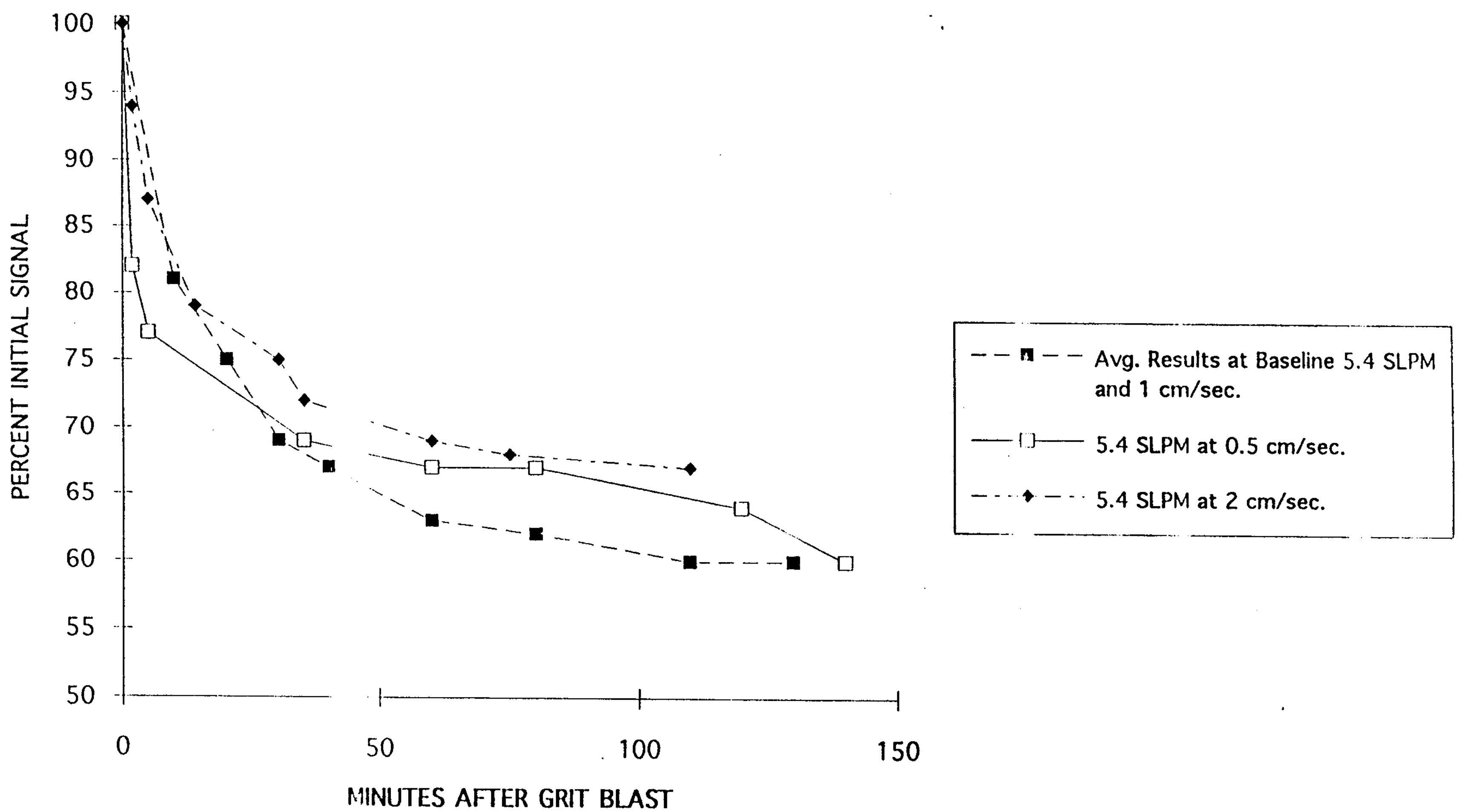
Scan parameters: 1/4" stand-off, speed 1 cm/sec., continuous mode. Typical environmental conditions were 74-76F and 20-30% RH. Grit blast angle 20 degrees. AC80g/6/96

Figure 69: EFFECT OF ARGON PURGE RATE ON OSEE III PERCENT SIGNAL CHANGES OVER TIME FOR D6AC STEEL



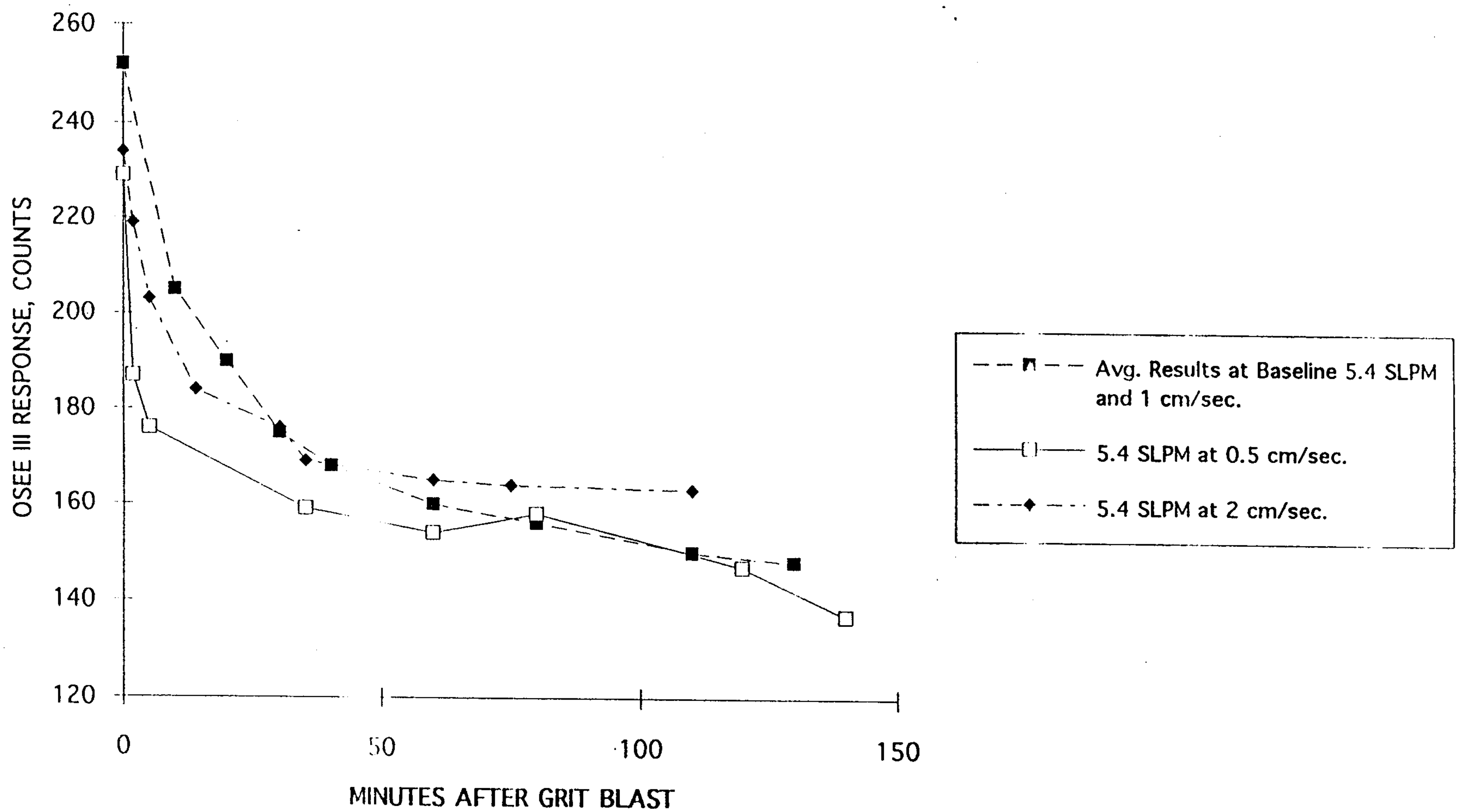
Scan parameters: 1/4" stand-off, speed 1 cm/sec., continuous mode. Typical environmental conditions were 74-76F and 20-30% RH. Grit blast angle 20 degrees. AC80h/6/96

Figure 70: EFFECTS OF ARGON FLOW RATE TO SENSOR/SUBSTRATE GAP REGION AND SCAN RATE ON OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL



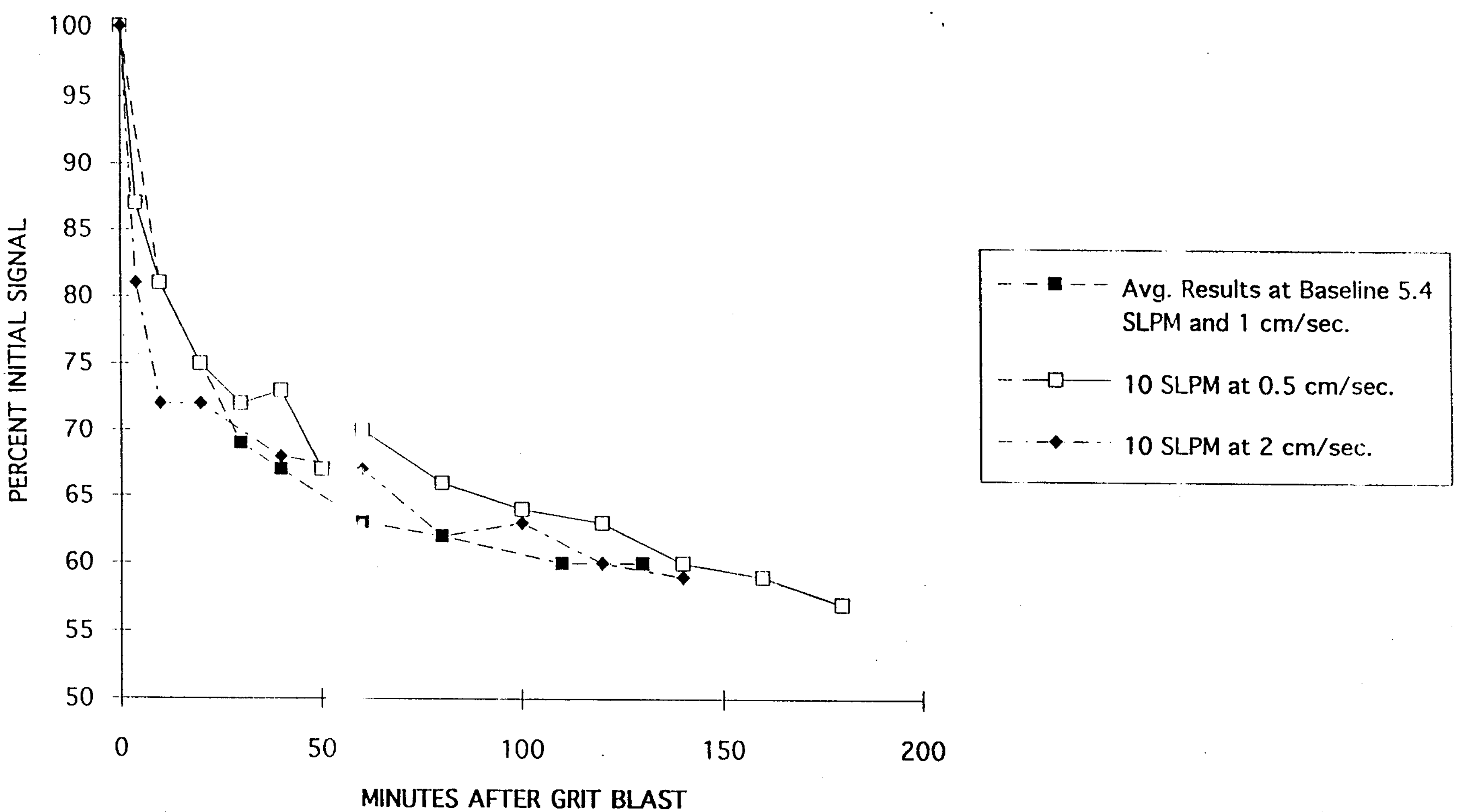
Scan parameters: 1/4" stand-off, continuous mode. Grit blast angles were 20 degrees. Typical environmental conditions were 75F and 30% RH. AC80ob/6/96

Figure 71: EFFECTS OF ARGON FLOW RATE TO SENSOR/SUBSTRATE GAP REGION AND SCAN RATE ON OSEE III ANALYSES OF D6AC STEEL



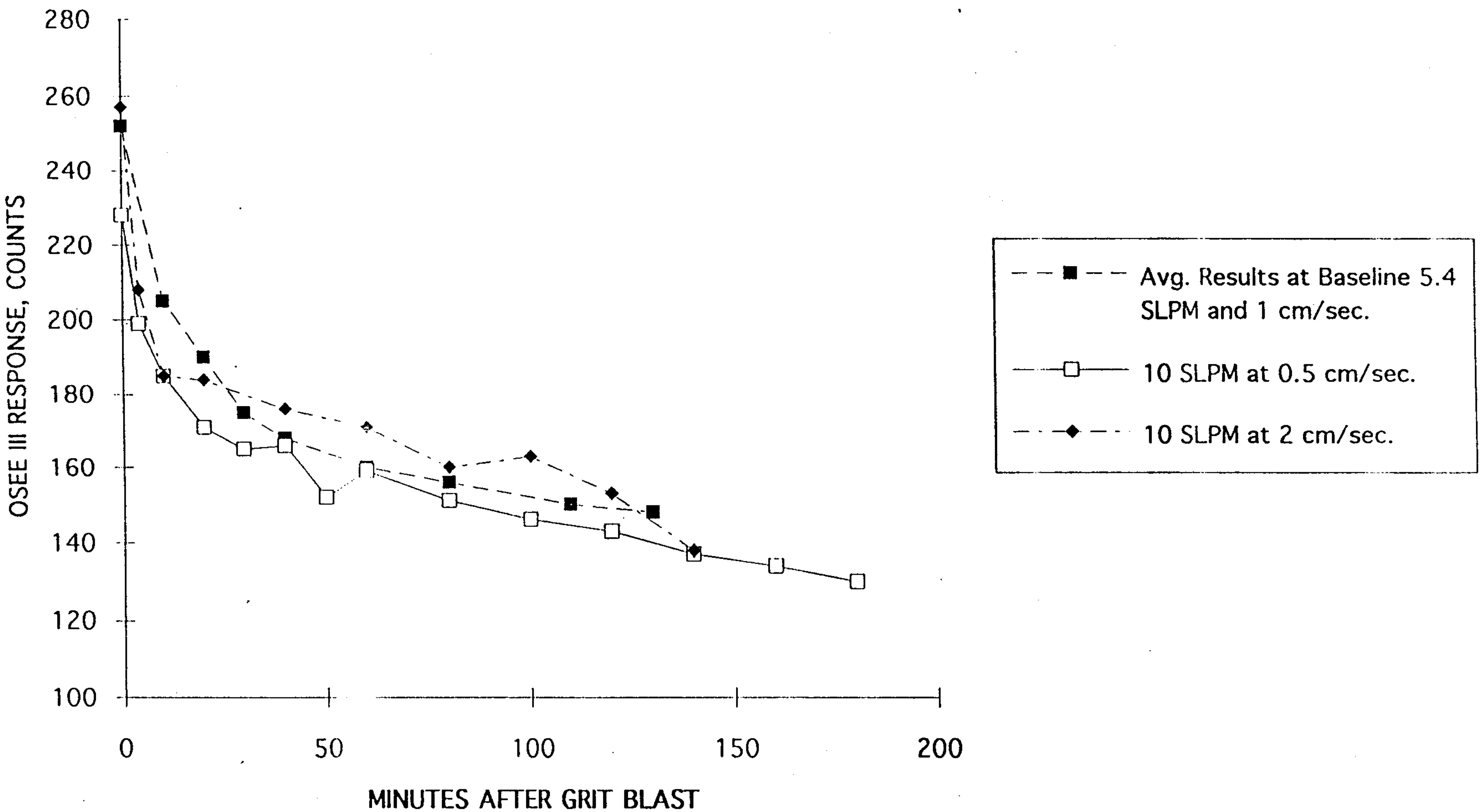
Scan parameters: 1/4" stand-off, continuous mode. Grit blast angles were 20 degrees. Typical environmental conditions were 75F and 30% RH. AC80lb/6/96

Figure 72: EFFECTS OF ARGON FLOW RATE TO SENSOR/SUBSTRATE GAP REGION AND SCAN RATE ON OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL



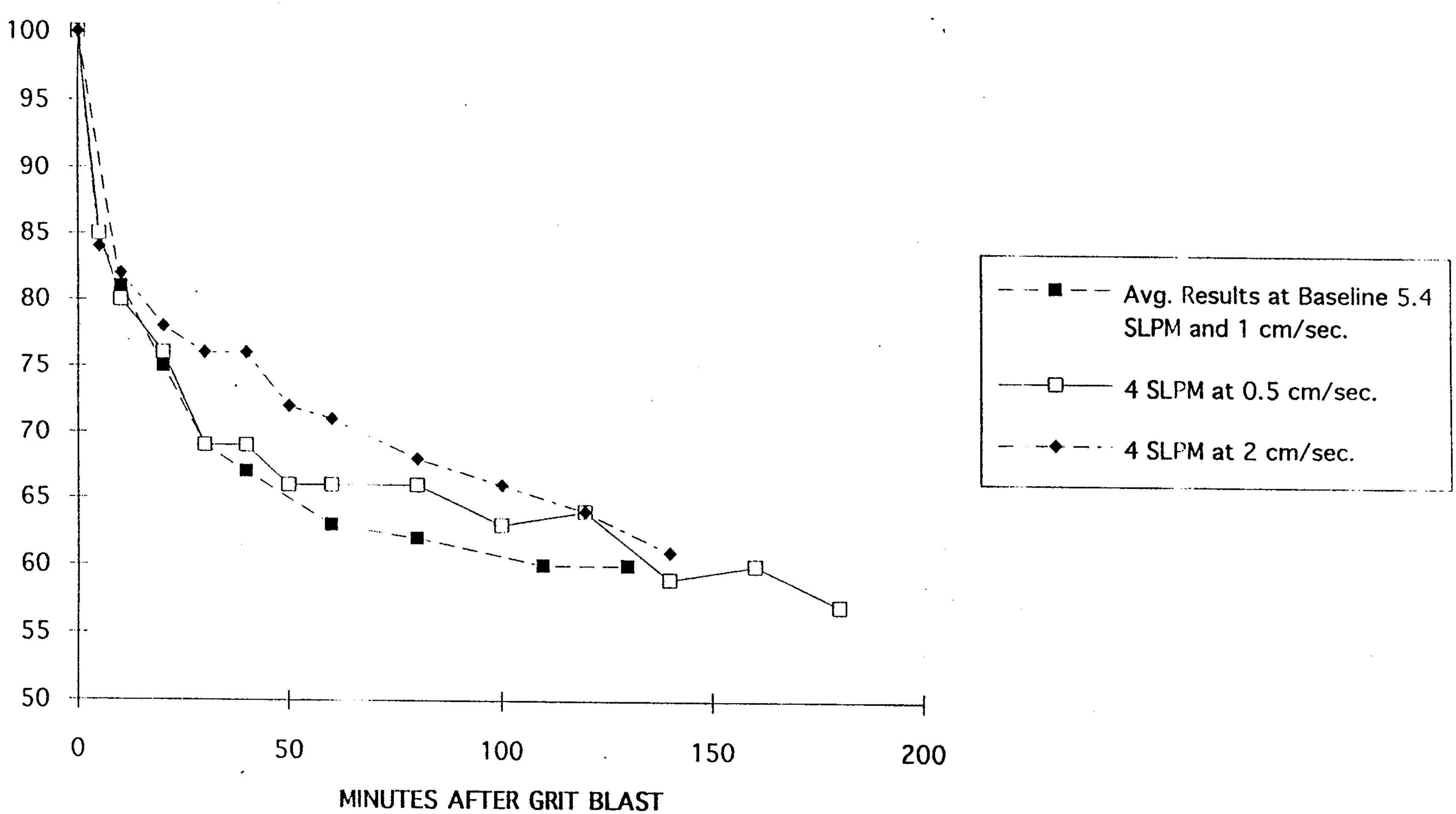
Scan parameters: 1/4" stand-off, continuous mode. Grit blast angles were 20 degrees. Typical environmental conditions were 75F and 30% RH. AC80pb/6/96

Figure 73 : EFFECTS OF ARGON FLOW RATE TO SENSOR/SUBSTRATE GAP REGION AND SCAN RATE ON OSEE III ANALYSES OF D6AC STEEL



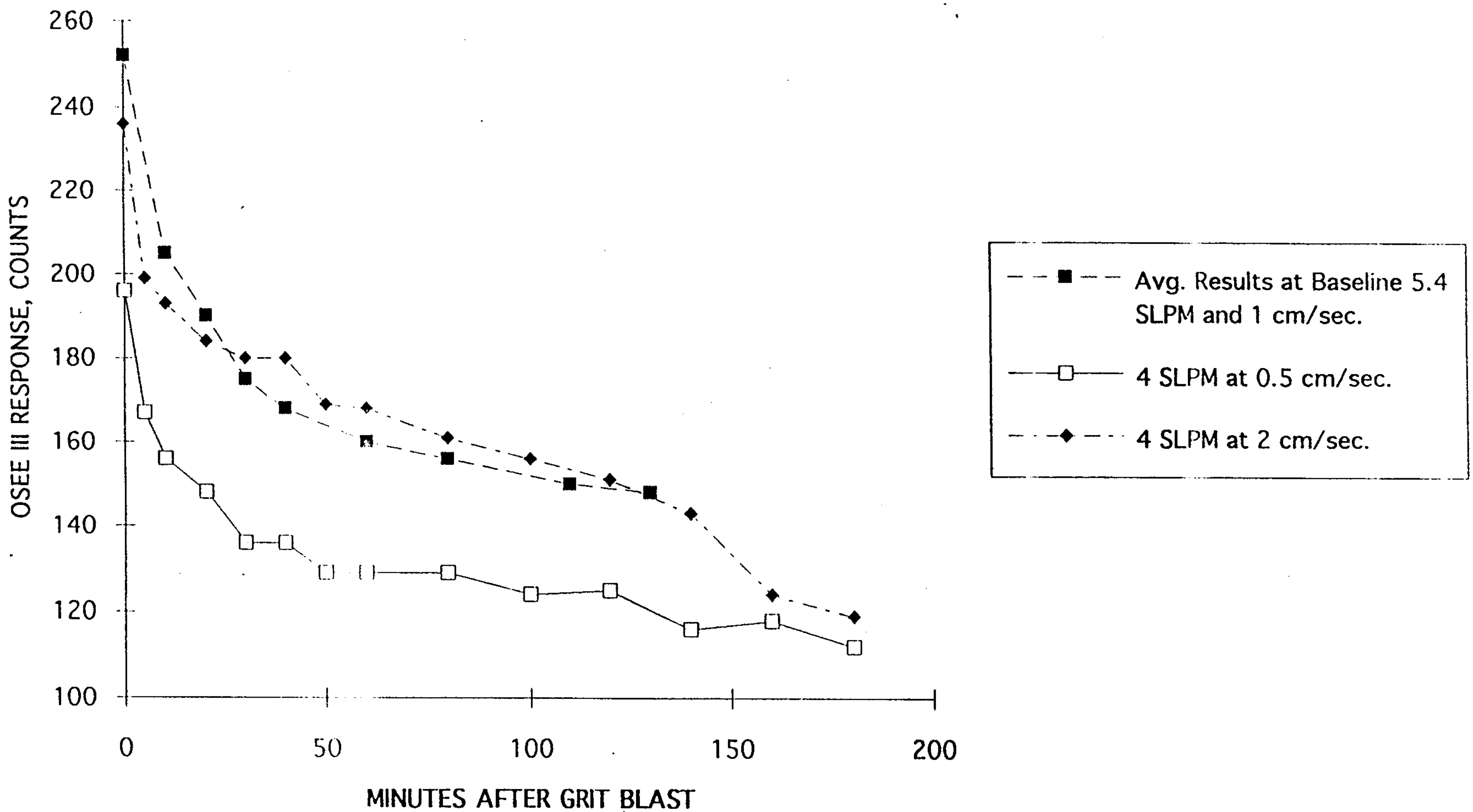
Scan parameters: 1/4" stand-off, continuous mode. Grit blast angles were 20 degrees. Typical environmental conditions were 75F and 30% RH. AC80mb/6/96

Figure 74 : EFFECTS OF ARGON FLOW RATE TO SENSOR/SUBSTRATE GAP REGION AND SCAN RATE ON OSEE III PERCENT SIGNAL CHANGES FOR D6AC STEEL



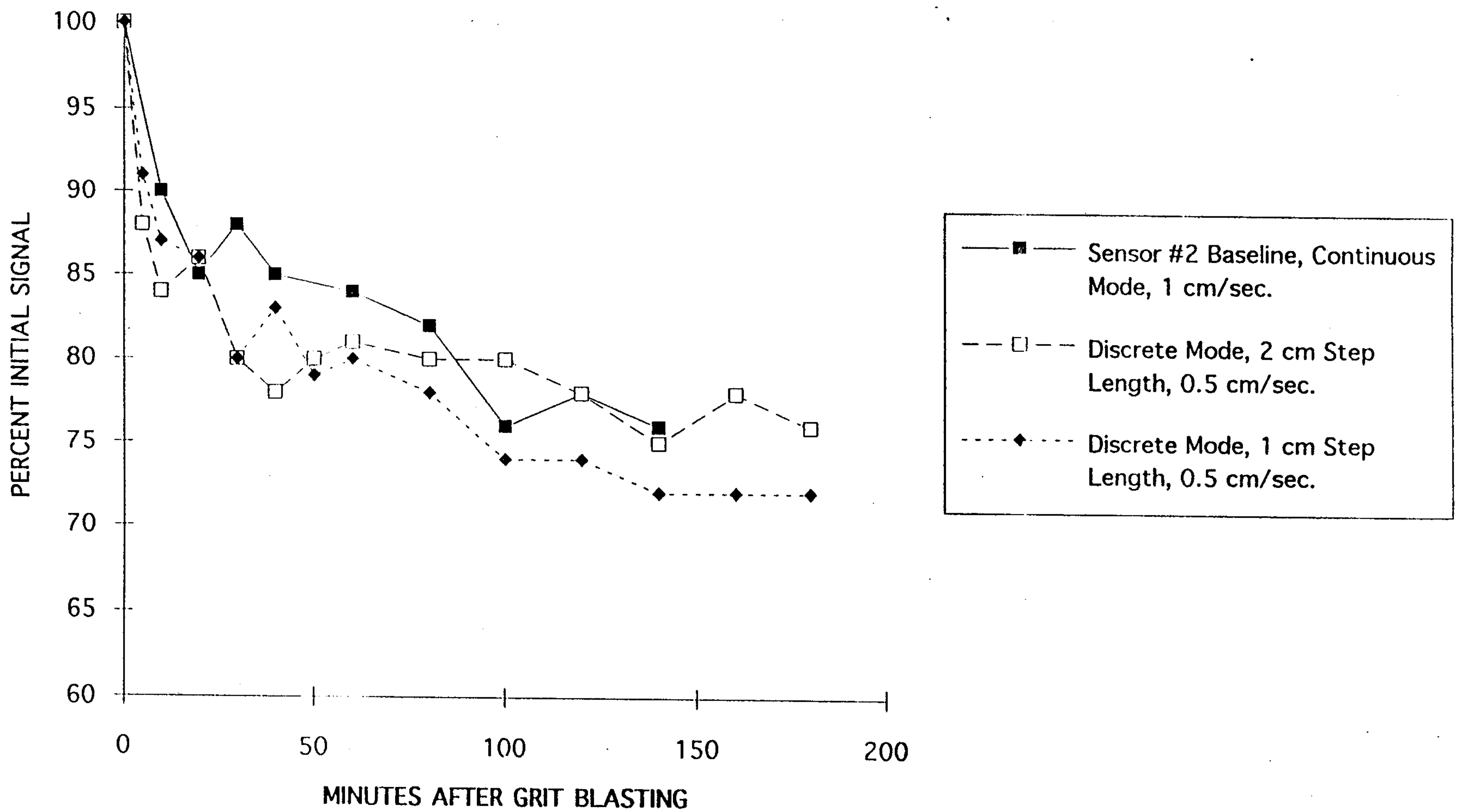
Scan parameters: 1/4" stand-off, continuous mode. Grit blast angles were 20 degrees. Typical environmental conditions were 75F and 30% RH. AC80qb/6/96

Figure 75 : EFFECTS OF ARGON FLOW RATE TO SENSOR/SUBSTRATE GAP REGION AND SCAN RATE ON OSEE III ANALYSES OF D6AC STEEL



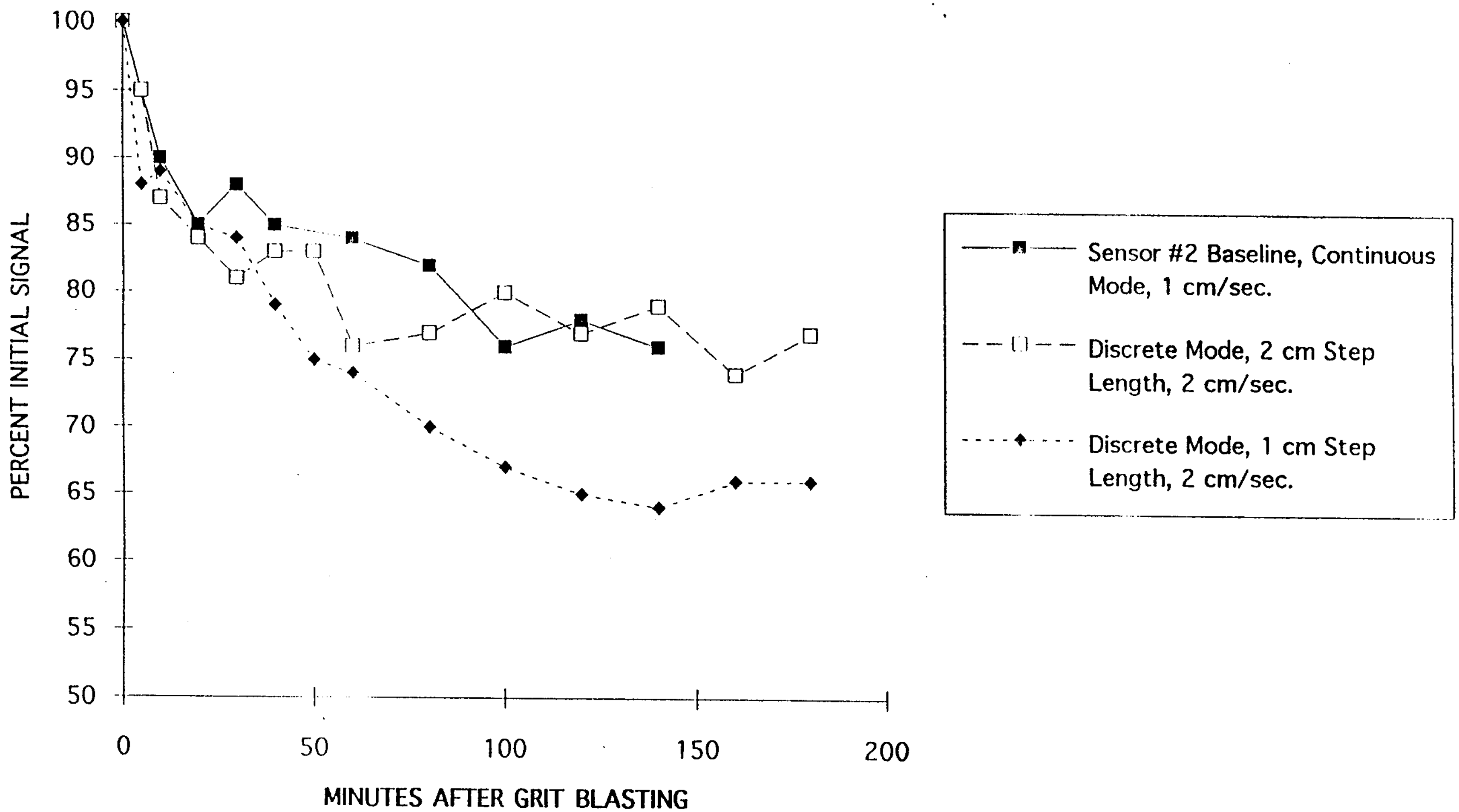
Scan parameters: 1/4" stand-off, continuous mode. Grit blast angles were 20 degrees. Typical environmental conditions were 75F and 30% RH. AC80nb/6/96

Figure 76 : RESULTS FROM OSEE III ANALYSES OF GRIT BLASTED D6AC STEEL PANELS WITH DISCRETE AND CONTINUOUS SCANNING MODES



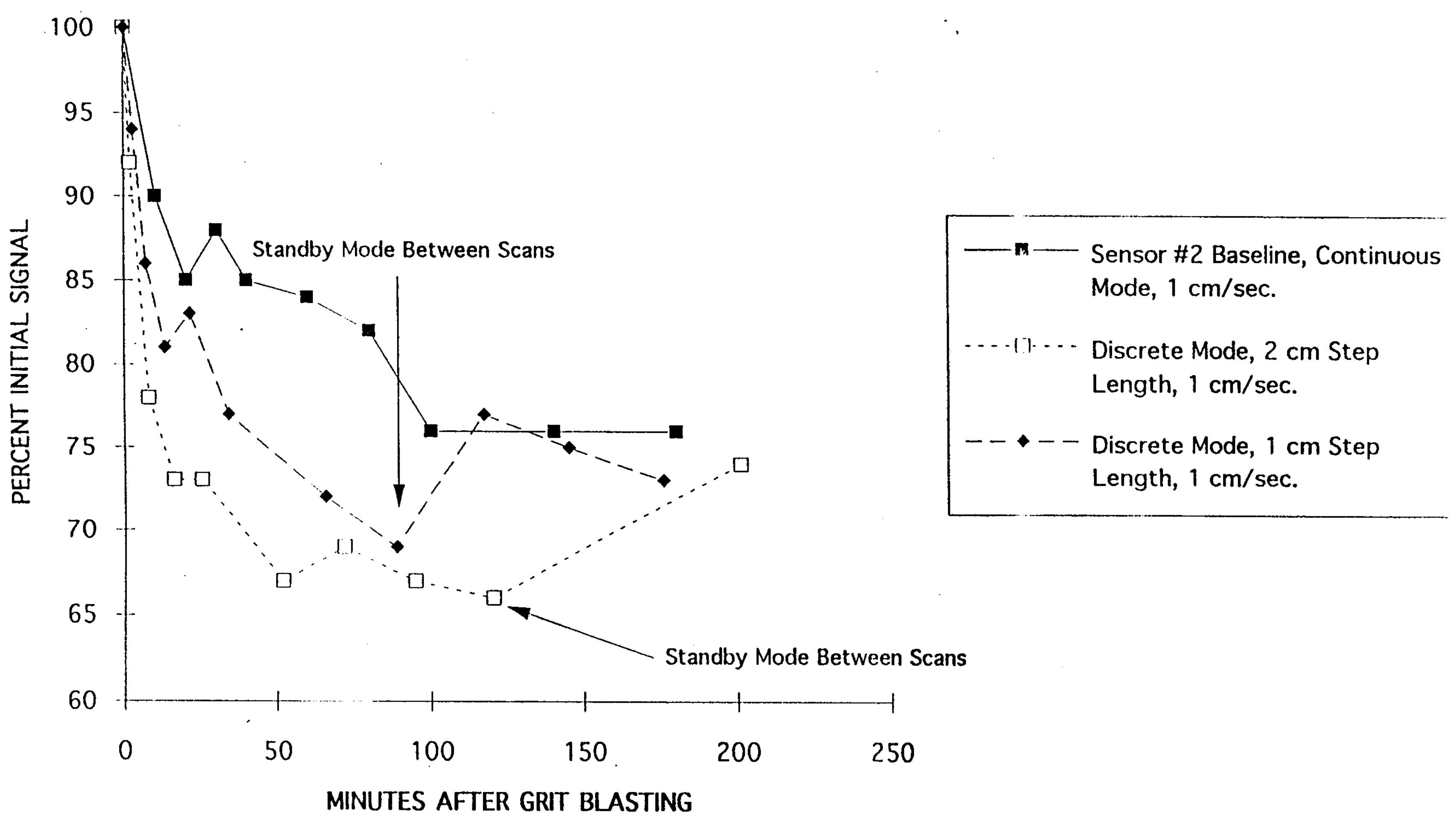
Stand-off distance 1/4", argon flow rate to sensor/substrate gap=5.4 SLPM. Panels grit blasted at 20 degrees with Zirclean. Typical environmental conditions were 74-76F and 35-40% RH. AC80ub/6/96

Figure 77 : RESULTS FROM OSEE III ANALYSES OF GRIT BLASTED D6AC STEEL PANELS WITH DISCRETE AND CONTINUOUS SCANNING MODES



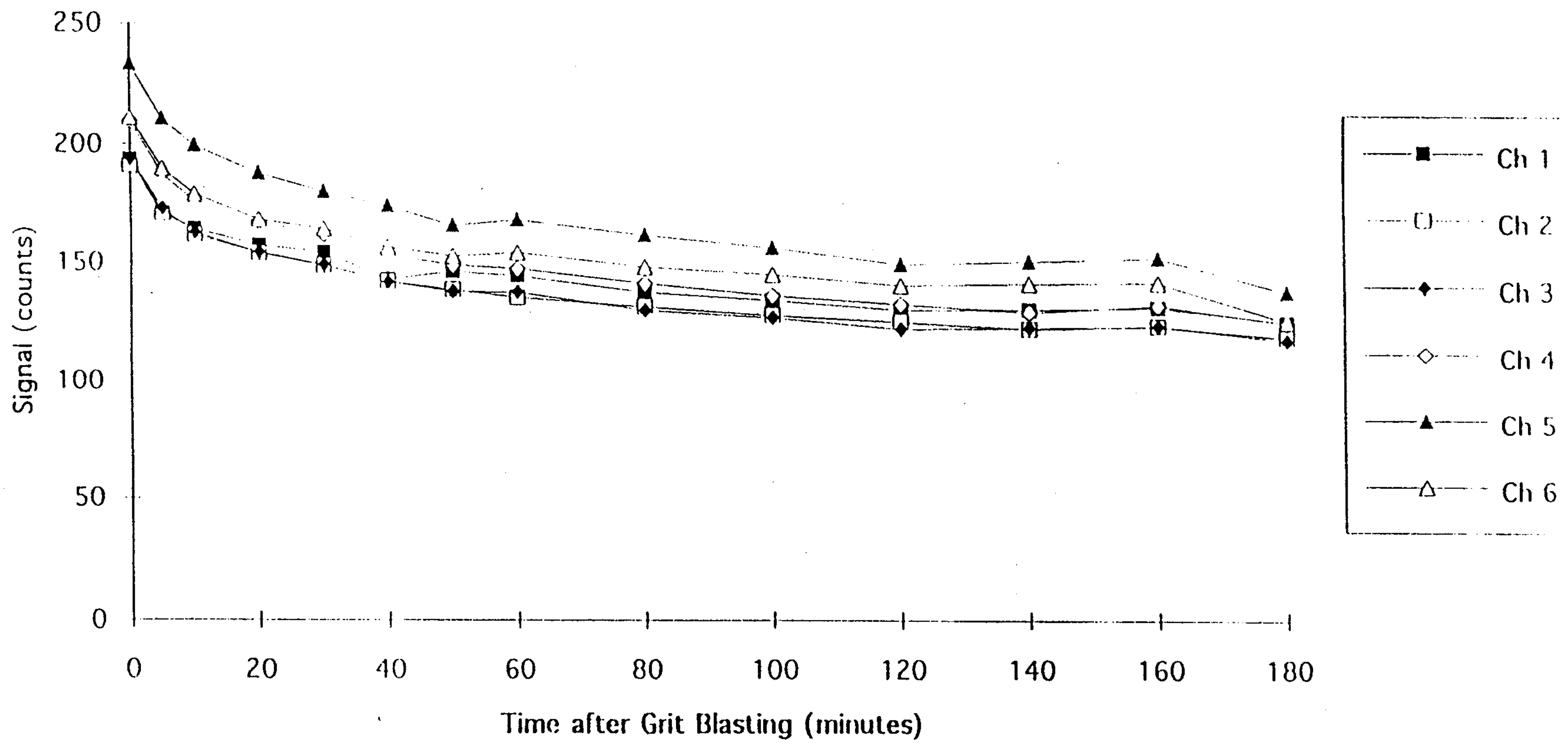
Stand-off distance 1/4", argon flow rate to sensor/substrate gap=5.4 SLPM. Panels grit blasted at 20 degrees with Zirclean. Typical environmental conditions were 74-76F and 35-40% RH. AC80vb/6/96

Figure 78 : RESULTS FROM OSEE III ANALYSES OF GRIT BLASTED D6AC STEEL PANELS WITH DISCRETE AND CONTINUOUS SCANNING MODES



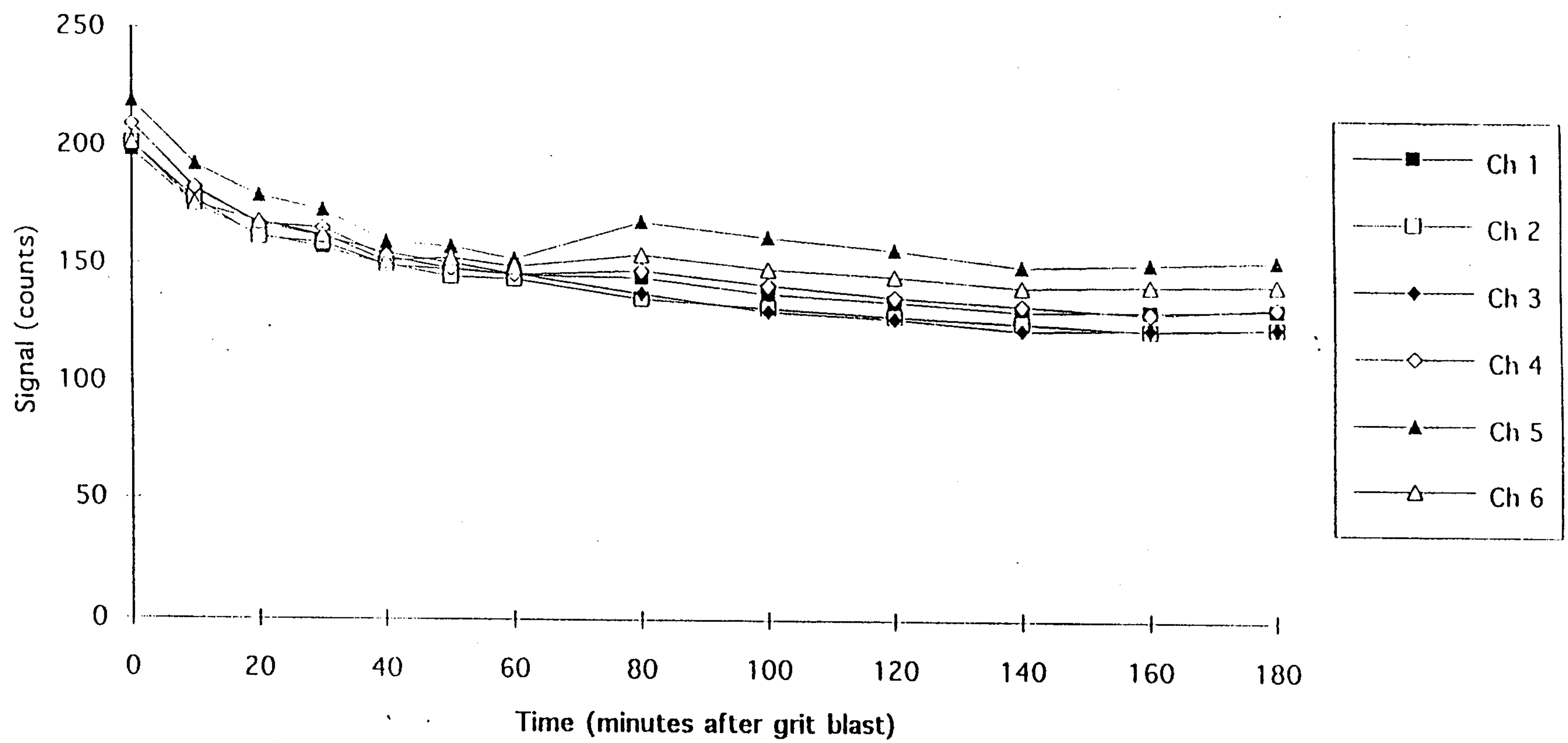
Stand-off distance 1/4". Panels grit blasted at 20 degrees with Zirclean. Typical environmental conditions were 74F and 38% RH.
AC80t/6/96

Figure 79 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "OLD" RACK, SENSOR #2



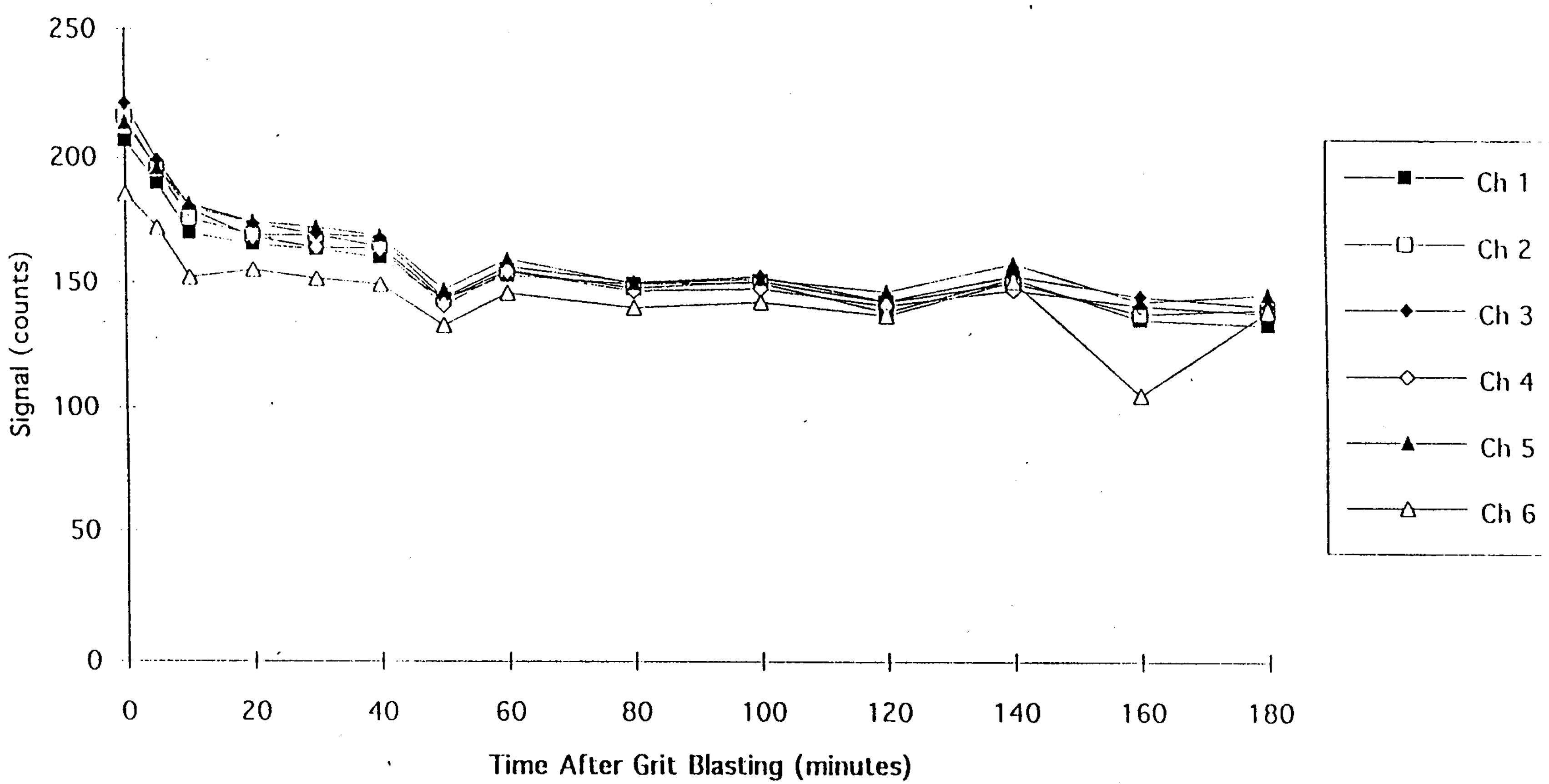
Continuous mode, 1 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "Old" rack (NASA #1255351)

Figure 80 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "OLD" RACK, SENSOR #2



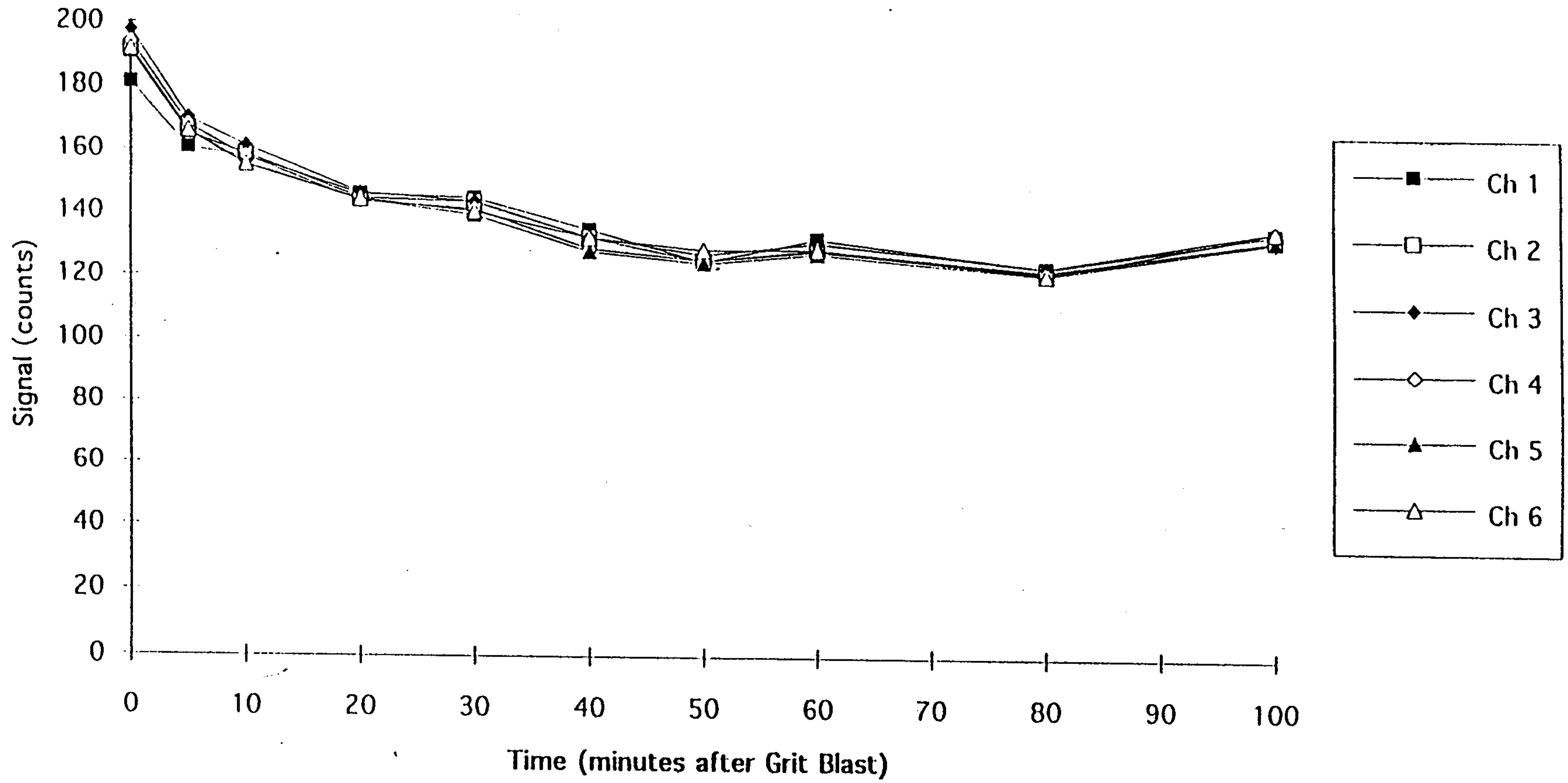
Continuous scan mode, 1 cm/sec. scan speed. 20 degree grit-blast, with Zirclean blast media. "Old" race (NASA #1255351)

Figure 81 : OSEE III RESPONSE OVER D6AC STEEL - "OLD" RACK, SENSOR #2



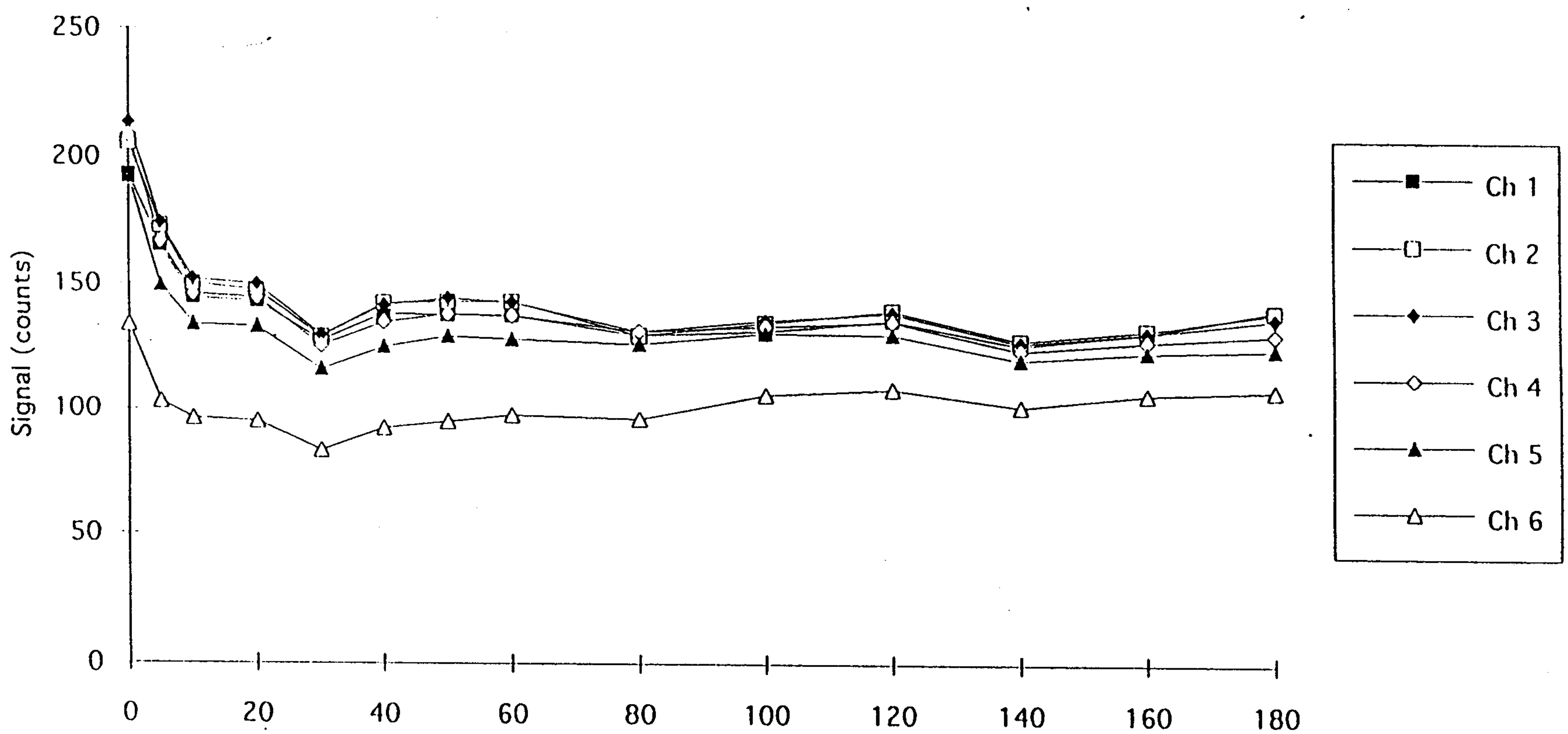
Continuous mode, 2 cm/sec scan speed. 20 degree grit-blast, with Zirclean blast media. "Old" rack (NASA #1255351)

Figure 82 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #2



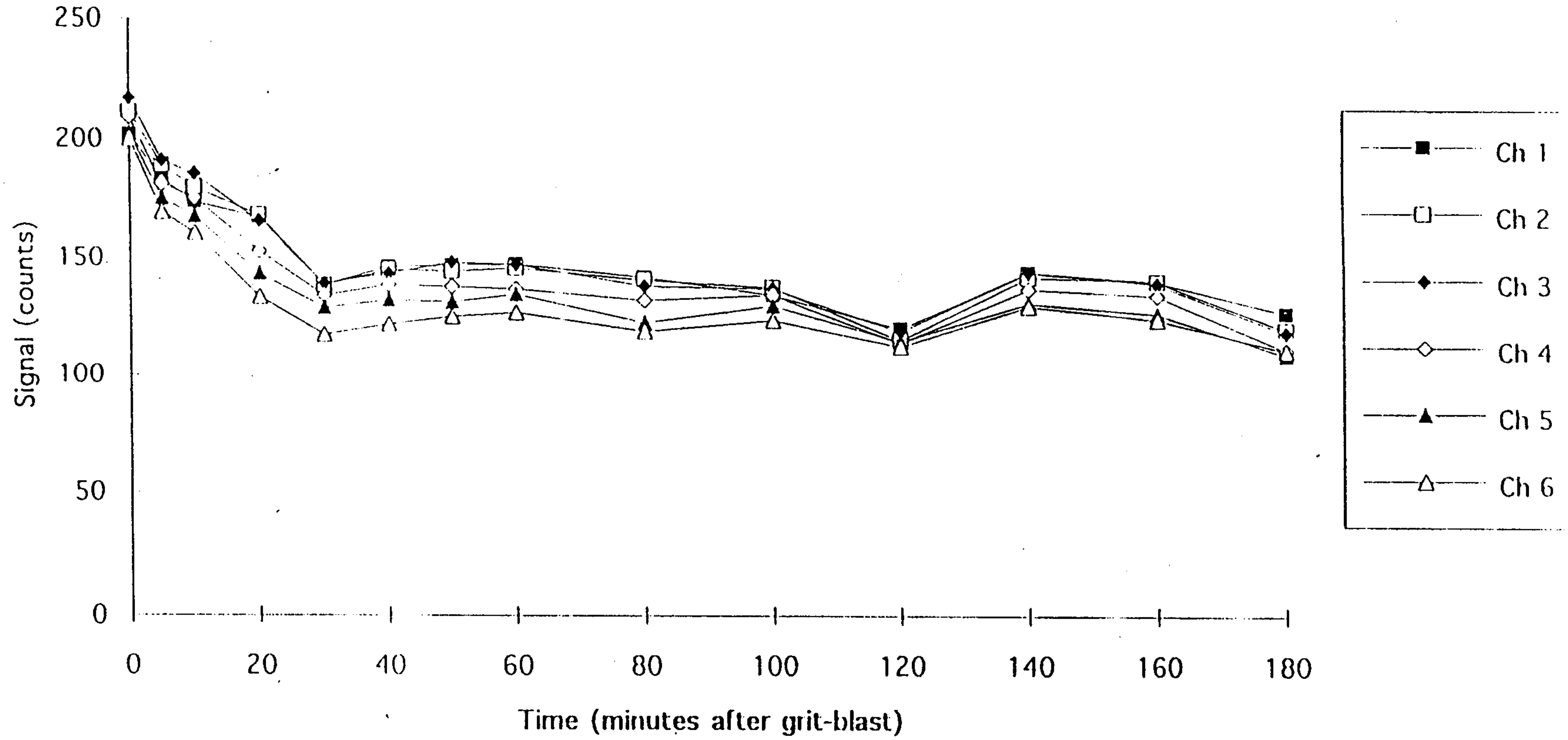
Continuous scanning, 1 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "New" rack (NASA #1255352)

Figure 83 : OSEE III SIGNAL RESPONSE TO D6AC STEEL - "NEW" RACK, SENSOR #2



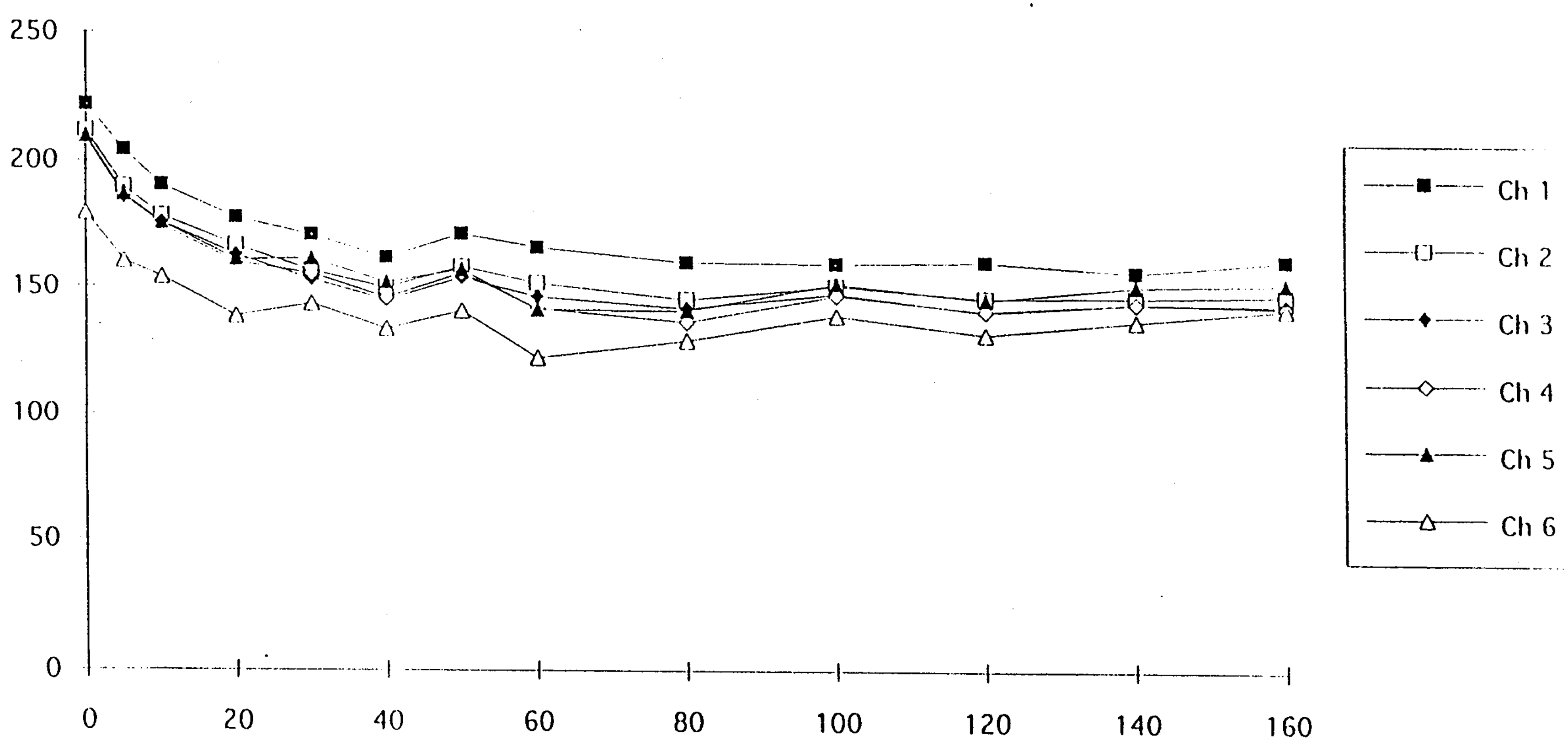
Continuous scanning, 1 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "New" rack (NASA #1255352).

Figure 84 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #2



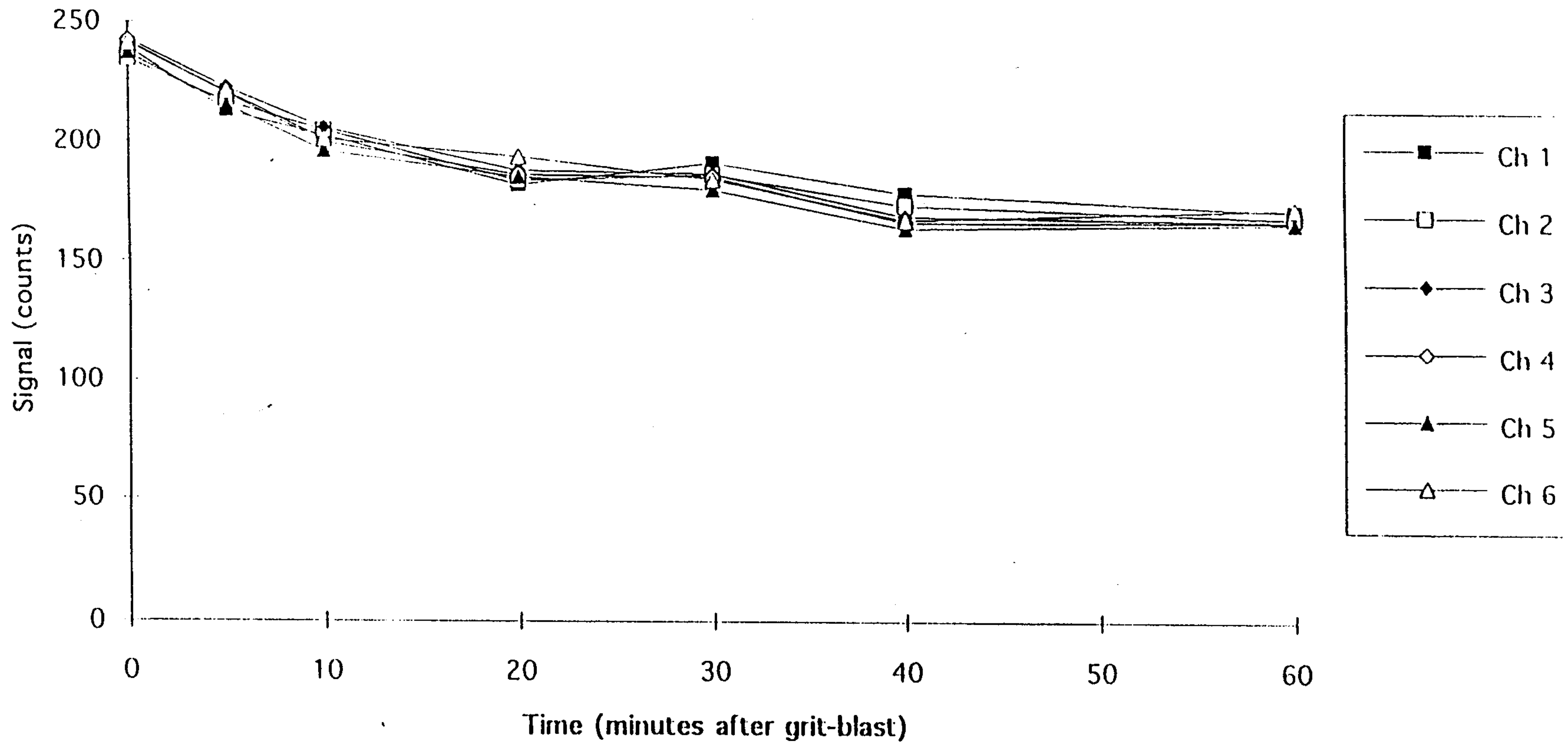
Continuous mode, 2 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "New" rack (NASA #1255352)

Figure 85 : OSEE SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #2



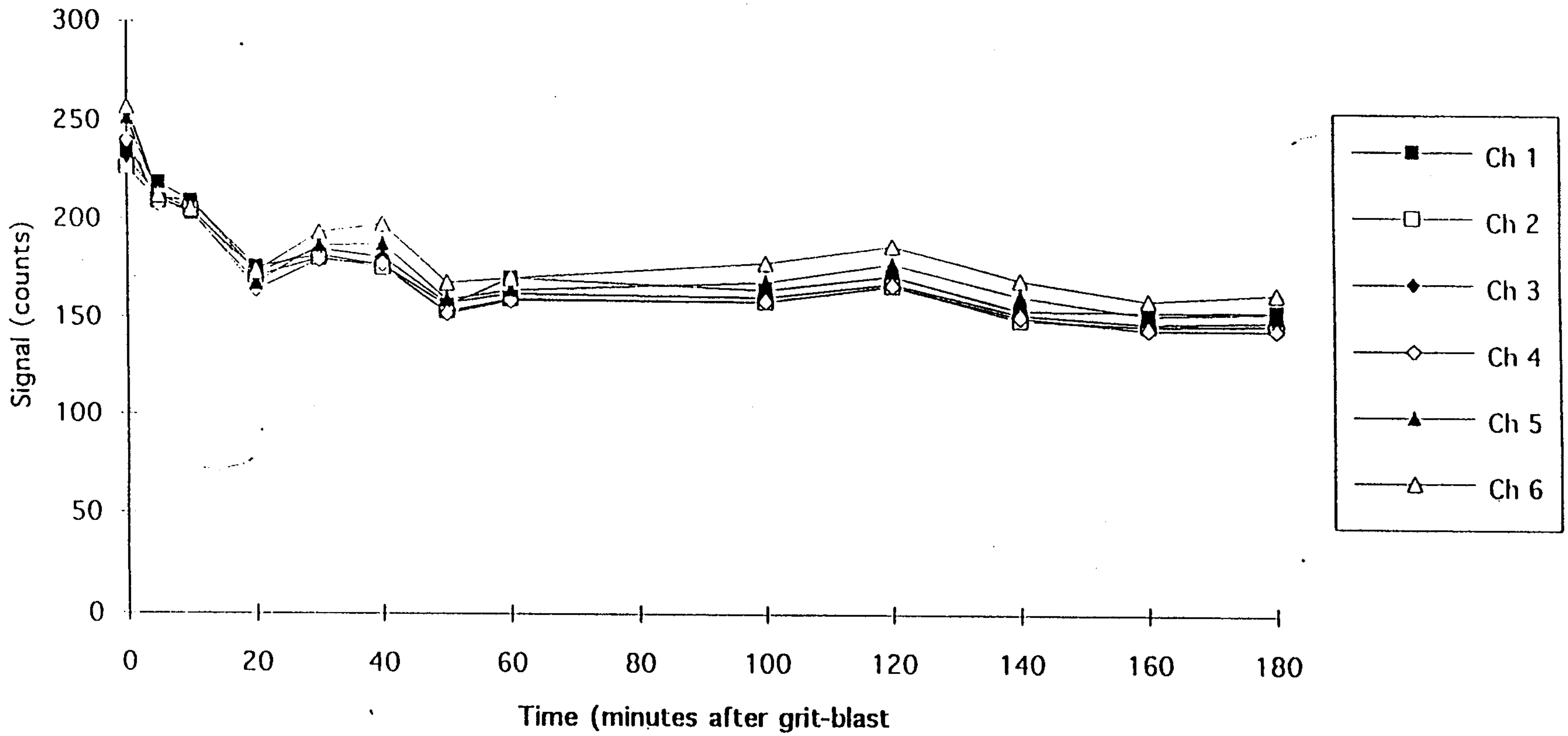
Continuous mode, 0.5 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "New" rack (NASA #1255352).

Figure 86 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #8



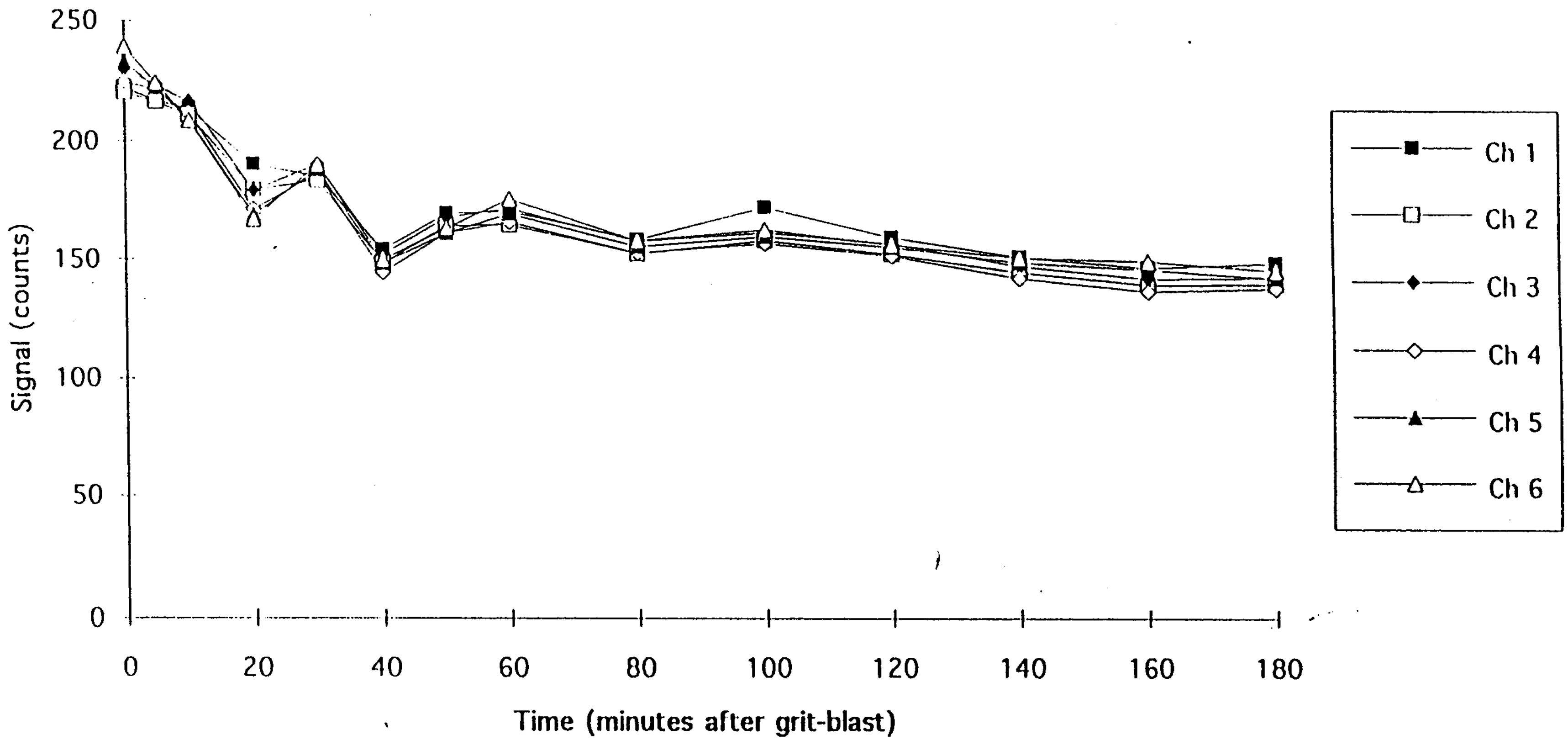
Continuous mode, 1 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "New" rack (NASA #125532)

Figure 87 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #8



Continuous mode, 1 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "New" rack (NASA #125532).

Figure 88 : OSEE III SIGNAL RESPONSE OVER D6AC STEEL - "NEW" RACK, SENSOR #8



Continuous mode, 2 cm/sec scan speed. 20 degree grit-blast angle, with Zirclean blast media. "New" rack (NASA #125532).